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OF THE

AMERICAN PEAT SOIETY

INCORPORATED

A QUARTERLY JOURNAL DEVOTED TO THE DIFFUSION OF KNOWLEDGE CONCERNING PEAT AND TO THE UTILIZATION OF AMERICAN PEAT RESOURCES

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Journal of the
American Peat Society

Vol. XV. JANUARY, 1922 No. 1.

THE RELATION OF PEAT TO THE GRASS RUG INDUSTRY.[1]

By Myron W. Robinson,
President Crex Carpet Co.

Introduction.

American grass rugs are universally used and no doubt you are more or less familiar with them, but I imagine you would find it difficult to associate these artistic floor coverings with peat. It is a fact, though, peat is essential to the production of all American grass rugs, and I am going to take a short space of your time with the history of an American industry—the story of the development and manufacture of a product of which the principal raw material is a plant growing on peat, and which, prior to the inception of this manufacture, had been considered a waste. I speak of *Carex stricta* or *Carex filiformis,* commonly called wire-grass, which grows only on the peat bogs such as are found in the States of Minnesota and Wisconsin.

The domestic grass rug manufacturers employ thousands of men and women in factories and grass fields, have an annual pay roll of over $1,000,000, and own or rent close to 100,000 acres of peat lands.

I am indebted for much of my data for this paper to Mr. C. A. Kellett, superintendent of our grass lands. Some of the members will recollect the visit to our camps at the Minneapolis convention.

[1]Prepared for the Fifteenth Annual Meeting of the American Peat Society, September 7, 1921, Hotel Commodore, New York City.

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NATURA

CAREX-STRICTA.

Wire grass is peculiar to a peat which is in an earlier stage of disintegration and decay than that peat classed as "muck" or well decomposed peat, and is what we call "raw peat". Its composition is such that the partially decayed forms of the plant life from which it is derived can be easily discerned. It is brown in color—not so dark as the older peats. In Minnesota and Wisconsin and in Canada near the Minnesota boundary, there are many hundreds of thousands of acres of this class of peat land which is producing this wire-grass, much of it of value for manufacture.

Early settlers in the Minnesota and Wisconsin Territories soon discovered that they could not cultivate these wire-grass bogs and that the grass was of no value for pasturage, containing nothing of nutritive value for cattle or domestic animals, and the immense tracts of marsh land lay a waste, while the country all around grew into cities and towns and prosperous farms, and it was not until 1897 that the first successful attempt was made to bend this wastrel of nature to the use of man. Wire grass only grows in its well developed form on marshes and bogs where there is an abundance of peat.

The wire-grass is not a true grass, differing from the true grasses in that it has a solid stem growing up from the roots, without joints or leaves. It is perennial in growth and bears seeds at irregular intervals; seed pods have been observed two years in succession and at other times none have been seen for several years. The grass is an olive green in color, triangular in form, although some localities produce a round-stemmed grass which is not so desirable for manufacturing as the more common variety. It is about one-tenth of an inch in thickness, tapers from the butt to the tip and reaches an average height of three feet although growths as tall as six feet are not uncommon. It is fibrous, tough and pliable, hence its common name.

Carex stricta is almost entirely devoid of mineral substances on account of growing in peat and bog marshes where there is a marked absence of mineral qualities. Besides being deficient in lime and potash, the soil is also poor in nitrogen. The small content of these substances keeps the wire grass tough.

Development.

In 1897 George A. Lowry of Boston invented a spinner which successfully spun the wire grass into twine. The principle of this spinner, with variations, is used in the manufacture of grass twine by all American grass rug manufacturers. Its early trials were so impressive that great haste was made to construct more machines, and in November, 1897, ten spinners were placed in operation for the purpose of making binding twine.

When making binding twine the fibers are twisted together and afterwards over-laid with a cotton twine to hold them together. This twisting of the fiber gives the twine greater tensile strength.

The original company which was formed to manufacture binding twine grew very rapidly, purchased thousands of acres of the wire-grass peat lands, constructed roads and telephone lines across the marshes, and built camp buildings to house the crews during the harvest season; irrigation ditches were dug for miles so that bogs might be drained to permit the cutting of the grass, and later flooded to bring out the new growth. By 1902 hundreds of people were engaged in the harvest of grass and its manufacture into binding twine.

A great deal of credit is due the pioneers of the industry for the subjugation of obstacles which seemed unsurmountable, for their foresight in obtaining large tracts of the peat lands so as to control the irrigation and insure crops of grass in sufficient quantities to care for future growths of the business, and most of all for their large expenditures of capital in an altogether new and untried proposition. It must be remembered that nothing nearly like this product had been manufactured before and that all the machinery used in the industry had been designed and especially built for the work.

As I have already stated, the spinners were originally placed in operation for the purpose of making binding twine and the manufacture of rugs was a development of experiments looking to the use of by-products of the grass binder twine industry. Binding twine was manufactured from 1898 to 1904 but the development of the weaving of grass carpet soon began to over-shadow all other phases of the industry.

The first grass carpeting was woven in 1898 at the Crex Carpet Company's mill at Oshkosh, Wisconsin, on a hand loom. It

was an immediate and decided success and the demand was so great that it was necessary to place in operation many hand looms to supply the trade before the special power looms could be built. At that time it was the custom to cover the floor of a room from wall to wall with carpeting 36 inches wide, and the first grass carpeting was made to meet that demand.

In use it was discovered that the carpet would wear unusually well, that it did not hold the dust raised by daily sweepings, and that it could be sold at a very attractive price, and soon the manufacture of binding twine was abandoned for the more profitable manufacture of carpeting—the forerunner of the beautiful rugs of today.

Recently this country has been flooded by a very inferior imitation of the grass rug, from Japan, which is not a grass rug at all, but a rice straw rug, not as durable, as sanitary, or as well made.

Modern Manufacture.

In describing modern manufacturing methods, the first step would be the method of caring for the peat meadows and the manner in which the grass is cut and cured. The grass, for its best growth, in fact, for its very existence, requires that the peat meadows be covered with several inches of surface water during the fall and winter and spring months, and at the same time it is necessary to remove the water so that the meadows will be dry enough to bear the weights of the machinery and horses used during the harvest season. The water is controlled by means of shallow ditches which are dammed; the dams being removed in the spring and replaced in the fall, after the harvest has been completed. To learn how to let on and take off the water at proper seasons to encourage the largest and best growth of grass was a trying problem. Much had to be obtained by practical knowledge and experience.

In late years many county and state ditching projects have been put through which have in most cases dried out the peat marshes and killed the wire grass in their vicinity. It is a grave mistake to meddle with the drainage of these peat lands, destroying and curtailing the only use they have been put to in a practical way, unless they are further developed in a scientific way, but to simply dry out and leave has been a big expense and big loss.

The machinery and methods used in procuring the grass just

now are in a transitory stage between horse-power and gasoline tractors, and a description of the same will necessitate an inclusion of part of the detail of each method.

The smaller meadows are still being cut with self-rake, old fashioned reapers, which cut the grass and leave it in bunches called "gavels." The reapers are drawn by horses. It was found difficult to give the horses footing on the soft bog and their feet would break through, causing them to mire, and this has been overcome by fitting them with flat wooden shoes, about a foot square, called "bog-shoes". The gavels left after the reapers are spread out by hand in an even swathe to be cured and later bound into bundles.

The more recently devised method of cutting involves the use of a modification of the grain binder—a grain binder with the binding apparatus removed and in its stead an especially constructed and patented device called a "grass turner". The grass is cut and elevated from the cutting bar in the same manner as if it were to be bound into bundles, but instead is dropped loose on the revolving apron of the turner which turns it at right angles from its cutting position and then drops it in an even, continuous swathe in the meadow behind the machine. The motive power for these machines is furnished by caterpillar type tractors. Our own company use the Bell trail tractor, manufactured in St. Paul, especially adapted for work on marsh lands.

Usually three days of fair weather will cure the grass sufficiently so that it may be bound into bundles similar to grain bundles. This is sometimes done by hand but more often by an especially devised machine called a "gleaner". The gleaner straddles the swathe of grass and picks it up, missing not a spear,elevates it to the knotter where it is tied into a bundle and then dropped out behind the machine. The gleaner is drawn by horses.

The bundles of grass may be stacked at once and it has been found that the grass comes out of stack in better shape when placed in a stack oblong in shape about 15 feet high and 30 feet long. In stack the grass goes through what is known as a "sweat", becoming slightly heated and loses part of the excess moisture. After six weeks in stack the grass is cured and ready to be baled.

The harvest season commences about the first of July and continues until the middle of September or until the grass has become too dry and brittle for manufacturing or until the frost has killed it.

The pressing into bales and hauling of the bales to the railroad

shipping points or to warehouses is done during the winter months. The baling press is built for this work, looks something like a cotton press and turns out a bale weighing about 200 pounds. In pressing care must be taken to lay the bundles in the press straight, butts and tips of each bundle alternating.

I might go into further detail as to the number of camps used in cutting and the enormous detail of caring for, housing and feeding hundreds of horses and men. But while interesting, I would enjoy much more extending to our members a welcome at any time.

After the grass reaches the mills the first process is to select and separate the longer fibres from the short and remove the true grasses and weeds. To do this the grass is drawn by hand through a hackle or comb and the grass of the desired length retained in the hand. The shorter grass, weeds, and true grasses which are a waste, are sold for packing glass and crockery, and are also made into pads for packing furniture. A coarse paper has been made of the wire-grass fiber but at a cost that was prohibitive of manufacture.

The long fibers of the grass are then placed in the spinner to be spun into twine. The spinner picks up the grass a spear at a time, placing them in a parallel position to be cast with a cotton thread and drawn out by rollers to a coil which is wound to weigh about 50 pounds.

The method of weaving the grass twine into carpet does not differ greatly from these methods used in fabricating other textiles and I won't go into detail.

The looms built for this class of work have a single box, larger than usual, shuttles, and a large lay. The twine, which is used as filler, is wound off the coil to make an egg-shaped spool about 16 inches long and from 2 to 3 inches in diameter, and taper at the ends, and in this process is called a "cop" and which fits into the loom shuttle. The carpeting is woven in widths from 27 inches to 12 feet and in rolls of about 50 yards.

The color effects of the rugs are reached partly through the colors of the cotton wound around the twine in combination with colored warps and then completed by stenciled patterns.

After weaving, the roll of carpet goes through various stages of inspection, burling, brushing, stenciling, binding, cutting into rugs, and packing.

Four companies are now manufacturing grass rugs in this country. Of these the Crex Carpet Company, with general offices at New York and Mills at Saint Paul, is the largest. The others are the Deltox Grass Rug Company and the Waite Grass Rug Company, both of Oshkosh, Wisconsin, and the Willow Grass Rug Company of Green Bay, Wisconsin; all having extensive properties and making the genuine grass rug.

In giving you the foregoing description of manufacture I have aimed to avoid too much detail and have tried only to bring out the salient points of process. Methods and processes I have dismissed with a few words, cost thousands of dollars and took years to develop. I have told you nothing of the magnitude of the industry today; nothing of its steady up-hill fight against cheap foreign imitations; nothing of the hundreds of people engaged in the craft of wresting from nature an inexpensive floor-covering for the American home.

I might add to a considerable extent on the manufacture but my main idea was to call to the attention of the society the thousands of acres of peat lands used for wire grass purposes.

FACTORS THAT CONTROL THE SUCCESSFUL PRODUCTION OF PEAT.[1]

By John N. Hoff,
Alphano Humus Co.

Introduction.

Successful production is a term that can be interpreted in various ways, all more or less inter-dependent. Commercially the definition of successful production would be measured in profits and dividends, and of course this measure of success is a necessary achievement for continued operation. It means profitable production of peat products in uniformity and volume sufficient to supply the market demand. Intermittent plant operation and output dependent on weather conditions has been the bugbear and well nigh fatal weakness in the industry. It requires an excess of raw material available regardless of weather and ability to operate steadily with predetermined output.

Markets.

The following factors have been outlined as fundamental considerations for successful production: markets, location, quantity, quality, transportation, surface conditions, drainage, etc. Quite wisely markets are given first consideration, because in the last analysis unless a market exists for any commodity it has small chance of a successful future. In the case of peat products the development of markets has been one of the things that has required dogged persistence, extensive advertising, education of the buying public, repeated experimentation, and finally conclusive demonstration of the merit of the product before any real markets could be said to have been established. Most of us know too well the long battle that peat has undergone in this connection, and now that the converts become more numerous and more ardent each year we feel that success has attended the peat industry in no small measure.

[1]Prepared for delivery during the Fifteenth Annual Convention of the American Peat Society in September, 1921, at New York City.

However, when all is said and done, we have not scratched the surface in commercial development of the markets outside of the fertilizer field. The uses of peat are so diverse and its products and by-products so numerous as to render their full exploitation possible only with the expenditure of much time, thought, and a large outlay of capital with profits more or less in the future.

On the subject of market conditions at the present time. the entire outlook runs a somewhat parallel course to that of other fertilizer materials. Perhaps at no time in the history of any fertilizer industry have conditions been so economically adverse as at the present time, but there is apparently a steadily growing tendency toward normalcy in the industry. Considering peat plants in the same category as fertilizer plants, it will be noted that it has not been necessary to charge off the extreme deficits that have been incurred by the mixed chemical concerns. The reason for this lies in the fact that most of us charge up our peat beds at such a small percentage of their market value as a finished product that this charge, usually only a few cents per ton in situ, will not vary despite market fluctuations.

Again the chief items in the expense of production of peat products are labor and coal, and it will be remembered that expenses for these had a downward trend at about the same time. While the fall has not been in direct proportion as the decline in prices of ammoniates, yet the fact that these items have fallen contemporaneously has been an aid toward minimizing the losses.

While the gross sales in the peat industry will necessarily be less than in the years just previous, still the decreases in the cost of production and the increased buying power of the profits will mean that the net result of peat operation is almost as good as normal and considerably better than a purely chemical mixing plant whose sole function is to take the finished product of one manufacturer, mix it with those of several others, and make his profits on the resale.

Apparently the market for dried humus ammoniate as a fertilizer ingredient has passed through its lowest ebb and the market for prepared humus as a manure substitute is increasing at an even more gratifying rate.

The market for fuel peat should be more or less local and removed from close proximity to our vast coal and oil supplies. It would be better to market its full value in the form of electrical

energy generated at or near the producing bog, with the saving of by-products so concentrated as to absorb otherwise prohibitive freight charges. As a fertilizer, peat and phosphate deposits in close proximity would aid in the production of ammoniated phosphate of greater value in available combination than peat ammoniate or phosphate produced separately.

So much for the markets. To me the introduction of peat into other industries in this country presents a field that demands research and scientific co-operation worth while.

Some forms of peat are suitable for paper making, to replace wood in buildings, and as a filler in roofing paper. It is used as a cheap insulating material in place of cork and as litter to replace straw and shavings.

Location.

On the subject of location, let us first consider that of the deposit itself. These points are patent.

It should have a central location with respect to the market.

It must enjoy facilities for adequate transportation. Peat is a bulky product and at the present time only large carriers such as the railroads or the steam ship lines can economically handle this relatively cheap commodity.

The peat bed for successful production must also have facities for drainage, either by natural or artificial means, and must also be in such a location that healthful living conditions are afforded in the immediate vicinity.

Location of the plant on the beds also requires careful consideration. There must be adequate transportation facilities for both the outgoing product and the incoming supplies.

It must have a supply of water favorable for the required uses. Acid peat water is not adapted for the best usage in steam boilers, and artesian water, available oft-times on peat deposits, is sometimes so heavily laden with lime and other minerals that its use is objectionable. Of course water treatments will sometimes obviate these troubles, but a proper study and analysis of the water conditions should precede the most advantageous location of a peat plant. The plant must have contact with the main highways and in this connection proper forethought as to the location of the plant may minimize the amount of road that will have to be

constructed over the peat lands. Lastly the plant should be located in a place that affords good foundations.

Quantity.

Successful production for an extended period will depend naturally upon the quantity of peat available. The inter-relation of quantity to the whole project is of primary importance. Firstly the quantity should be in direct proportion to the probable market. Secondly, the quantity available will definitely limit the amount that can be economically expended in plant and permanent community development. Quantity likewise must be considered in two dimensions rather than that of absolute volume. To be in workable quantity there must be sufficient depth of material to warrant the expenditure necessary to build industrial tracks, procure rolling stock, purchase machinery and erect power transmission lines. Likewise the depth must not be so great as to render the complete salvage either impossible or impractical. In fact the quantity and cheapness of production should permit the plant to be self-contained in that an excess sufficient for all fuel requirements of processing should be supplied from the peat itself either as a by-product gas or as powdered fuel.

Quality.

Quality is of fundamental importance for on it hinges the whole scheme of successful production. The higher the quality of the original peat, the higher the possible quality of the end product. Analysis is the first consideration, for whether the material is sold on that basis or not, the resulting benefits, all other factors being equal is bound to be in direct proportion.

From the standpoint of success financially this is also of primary importance because the expense of salvaging, preparing, drying, transporting and marketing low analysis goods will be as great or greater than one of better quality. Peat high in ammonia and low in mineral matter is essential in practically all cases.

Quality also considers the texture of the material and perhaps no one factor makes for success in greater measure. The texture or type of material will depend primarily upon the use to which it is to be put. Some industries demand material with a mini-

mum of decomposition, fibers intact and light in color. Fuel operations will demand high caloric value of such nature as to enhance the briquetting by either natural or artificial means. Material that is admirably adapted for wet process salvaging might be entirely ill-fitted to sun dry processes. As a fertilizer material it must be amenable to drying with a minimum of carbonization or combustion and should subsequently be delivered in a clean, uniform, finely granular state with only a small percentage of fines or dust.

Texture may likewise spell the success or failure of field operations, successful and economical handling in the mill, and lastly texture will impart to the prepared peat product that superior appearance that will welcome or debar it from the family of marketable commodities.

Transportation.

Transportation at the present time is one of the chief limiting factors of distribution. In any locality the justifiable selling market is dependent upon freight rates. The higher the delivery charges, the smaller the radius within which the commodity may be economically employed. In cases where the consumer is somewhat distantly removed from the point of production, entire candor and impartial analysis is necessary to decide whether the peat product possesses sufficient merit to warrant its use over another that might be available. Considering its bulkiness and the fundamental nature of its service, it appears that peat is deserving of especial consideration in the way of freight rates. In many instances we have been able to obtain satisfactory commodity rates that have extended our legitimate radius of marketing and lowered the cost to the ultimate user, but even at best a readjustment in rates would further the cause of successful peat plant operation.

Especially in Florida does the transportation by water route demand attention, and the establishment of a peat plant at a seaboard location appears to be of utmost importance.

Drainage.

Drainage in a measure is the secret of economical operation. As I view it the entire scheme of peat production, it is simply that of

dehydration. As it lies in nature the deposit may be anywhere between 85 and 95 percent of water. To remove this is peat production in a nutshell. A goodly proportion of this water drains away if given the opportunity. If drainage decreases the moisture content from 95 to 90 percent, it means that we are getting rid of that much water, and since any drainage will accomplish at least this much for us it means that no possible method of increasing the drainage facilities should be overlooked. For either commercial or agricultural pursuits on peat lands it is well to have the drainage work antedate such operations as far as practicable.

As you know I am firmly committed to the use of natures agencies in rendering peat ready for market. First attend to the ditching and allow the law of gravitation to work in drawing out the free water. Secondly, afford such conditions through surface disintegration and mulching as to permit a maximum dehydration by means of the sun and wind. After all, nature seems to have had the whole scheme worked out. Apparently nature has formed these great deposits of organic nitrogenous materials to help her out at some future date. Nature is provident. Nature provides the way to see her vast deposits put in shape for economical handling. After the sun and the wind have done their part it remains for man to simply gather these rich stores, add but a few simple finishing touches and return the material again to nature where it may accomplish a more abundant harvest.

Conclusions.

Market.—The market demand must be enlarged by better production methods and more diverse uses, lower freight rates, concentration of bulk in all ways possible, and processes so carried out as to be less dependent on climate and weather.

Location.—Peat being bulky and low in price, must be produced within easy shipping distance of assured consuming centers; for fertilizer use preferably at or near the Eastern or Southern Seaboard; for fuel far enough away from our coal mines to be free from that competition.

Quantity.—Large deposits are necessary to justify sufficient investment in plant and equipment of proper kind.

Quality.—The peat must be high in nitrogen and low in ash.

Transportation.—Always use water where possible; if railroads are used haulage must be with low freights.

Surface Conditions.—Bogs must be free from timber. If fit for agricultural work the peat is fit for economical gathering.

Drainage.—Dewatering is the great problem and is the first aid to nature in cheap production costs.

SWEET CORN AS A MUCK CROP.[1]

By James H. Beattie, Horticulturist,
Office of Horticultural and Pomological Investigations, Bureau of Plant Industry, U. S. Department of Agriculture.

Production of Sweet Corn for Canning.

The production of sweet corn for canning is an important industry. In point of acreage and tonnage it is second of the three most important vegetable crops, as shown by the accompanying table.

Table 1. Acreage and Production of Principal Canning Crops in the United States.

	1918		1919		1920	
	Acreage	Tons	Acreage	Tons	Acreage	Tons
Tomatoes	399,351	1,644,841	252,487	887,842	244,745	1,022,258
Peas	127,081	129,663	109,869	98,471	139,188	133,272
Corn	280,186	491,997	217,900	487,319	285,554	577,464

The industry is largely developed in the portions of the country lying between the hot lower South and the extremely short growing season portion of the upper North. The general area in which sweet corn is so largely grown embraces portions of Massachusetts, New York, Ohio, Indiana, Michigan, Wisconsin, and Minnesota where large areas of muck soils are to be found.

First Results from Muck Encouraging.

In the work of the Office of Horticultural and Pomological Investigations on the adaptation of truck crops to organic soils this crop has been studied as a possible canning crop on muck soil. The muck areas situated in the geographical section where sweet corn is largely grown for canning are as a rule short season soils on which it is difficult to mature field corn requiring about 120 days for its growth. The varieties of sweet corn ordinarily used for canning

[1]Delivered before the American Peat Society at their 1921 meeting Hotel Commodore, New York City.

require from 70 to 100 days to come to the stage of maturity at which the crop is usually harvested. It seemed that sweet corn might be grown with reasonable chances of success on muck areas where other crops requiring a long frost-free season would be more or less uncertain. Little was known, however, as to the behavior of the crop on muck. The co-operative work carried on in northern Indiana on the Kankakee marsh area by the society and our office presented a good opportunity to secure some information on this problem and, when work was actively resumed there in 1920, sweet corn was included in the list of crops to be studied. In the first year two acres of land were devoted to the crop with but one variety, Country Gentleman, being used. This variety was selected because it is one of the leading canning varieties. This season's work was a preliminary step towards the more detailed work planned and executed in 1921 and which we will discuss later. The crop was planted May 21 and harvested August 26 and September 4, giving a growing period of 92 to 96 days. A very satisfactory yield of good quality corn was secured. The average yield for the entire area was 2.62 tons per acre. When compared with the average yields for the United States, it will be noted that the crop secured was from the point of view of yield a satisfactory one.

Table 2. Acreage and Production of Sweet Corn in United States.

	1917	1918	1919	Average for 3 years
Acreage	203,055	280,186	217,900	233,714
Production In Tons	378,323	491,997	487,319	452,546
Yield Per Acre In Tons	1.8	1.8	2.2	1.93

Second Experiment Successful.

During the present season we have continued this work, using seven of the most promising varieties of sweet corn. The plots were one-sixth acre in size and all had the same fertilizer treatment, 400 pounds per acre of a 4-8-4 mixture. Table 3 gives the varieties and yield secured in this work.

Table 3. Variety Test of Sweet Corn on Kankakee Muck Steenburg, Indiana, 1921.

Variety	Yield Per Acre	
	Pounds	Tons
Golden Bantam	3,078	1.53
Crosby's Early	5,985	2.99
Mammoth White Cory	8,436	4.21
Country Gentleman	4,845	2.42
Early Evergreen	7,695	3.84
Late Evergreen	7,382	3.69
Charlevoix	12,768	6.38

The yield of all varieties tested, with the exception of Golden Bantam, was above the three year average of the canning crop of the United States. Charlevoix, a yellow variety and one that gives a very high quality canned product, gave a yield three times that of the average for the United States as shown in the table. Canning tests of the more promising varieties have been made, and as far as our results now show the product is in every way equal or superior to material grown on upland soils. The work will be continued and it is hoped that it can by another season be placed on a commercial basis utilizing a small experimental cannery for the handling of the product.

Possibilities Promising.

While sweet corn for canning cannot be looked upon as a crop that will utilize more than a small percentage of the muck areas available for its production, the aggregate acreage grown is large when compared with the usual muck crops, lettuce, cabbage, onions and celery. The time is a favorable one for the development of the industry, as yields of sweet corn on the areas devoted to its growth are low and liable to become even lower. This condition has been brought about by soil depletion due to poor farm practices and by diseases and insect enemies. The acreage value of sweet corn is not high as compared with lettuce or celery, and there is, of course, little prospect that the crop will be produced on the high-priced mucks now devoted to these crops, but it is a possibility for production on the low value areas of Ohio, Michigan, Indiana, Minnesota and other States.

COMMERCIAL BRIQUETTES FROM PEAT.[1]

By Albert L. Stilman,
General Briquetting Co.

Introduction.

In 1920 there was started a technical investigation for peat fuel along different lines from those heretofore attempted. A series of tests were run upon the Universal Press of the General Briquetting Company.

The "Universal" press, largely designed by Mr. E. B. A. Zwoyer, is the result of a comprehensive study of all types of roll or tangential presses and extended experience in operating briquette plants.

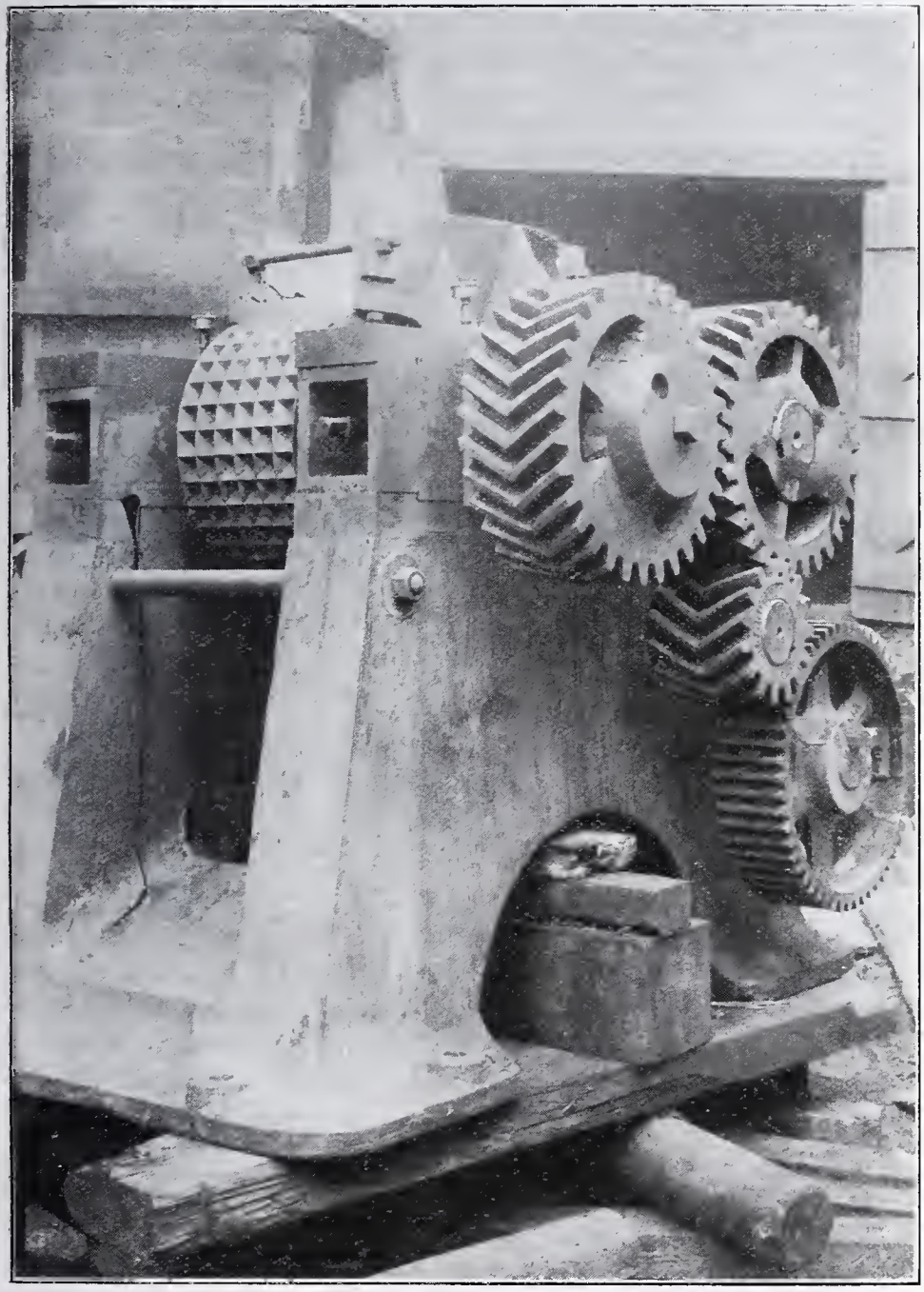
The press is exceedingly rugged and has the advantages therefrom of very little repair cost and smooth and even running. It is simple, having the fewest moving parts consistent with performance. The feed is especially noteworthy. It consists of a vertical hopper only, mounted directly above a pair of briquetting rolls. In the vertical hopper a column of material is fed, and the size and weight of the column determine the actual weight upon the briquettes. The weight of the material presses down upon the mixture actually undergoing pressure. The pressure of the material thus thrown against the rolls produces a reaction, which is exerted by the rolls themselves as pressure upon the forming briquette.

Details of the Press.

The press proper consists of a frame—a single casting comprising the base and two double-walled side girders, rolls, drive and feed. The side girders of the frame contain recesses for the bearings for the driving shaft and for the two intermediate shafts. Two heavy steel tie bars surmounting each of these girders take up the thrust of the rolls through the bearings.

The rolls are made of a special grade of iron and the pockets are cast in without machining, insuring hard wearing surface

[1]Paper presented before the Fifteenth Annual Meeting of the American Peat Society, September 7th, 1921, New York City.



Universal Briquetting Press.

and long life. The rolls are made in one piece and feed directly to the shaft without a spider. The diameter of the roll is proportional to the size of the briquette made. For a briquette 2 inches square weighing 2 ounces, or somewhat less in the case of fuels, rolls 20 inches in diameter are used

A machine with a roll speed of 22 R.P.M. has a capacity of 15 tons per hour, figured in anthracite coal. In the case of the peat briquettes, the capacity will be considerably reduced on account of subsequent drying. The capacity can be increased by increasing the number of rows of pockets longitudinally.

A patent helical key on one of the main gears is a special feature of the machine. This provides a rapid and effective means for matching the pockets of the two rolls.

Adjusting screws in the thrust blocks behind each of the roll bearings provide easy and quick adjustment of the roll centers for taking up the wear on the roll faces and in the roll bearings, also for adjusting the centre of the driven roll with relation to the intermediate driving shaft to suit the matching gear and pinion. Shims are provided between roll bearings and thrust blocks to maintain such adjustments when operating. Under no condition should the adjusting screws be used for this purpose.

The press is equipped with a 42 inch dia. x 10 inch face driving pulley, a suitable clutch, triple reduction of gears and heavy shafts. The driving shaft is extended for an outward bearing and stand, which are also furnished with the press.

The triple gear reduction permits a possible variation in the speed of the rolls from 8 R.P.M. to 22 R.P.M. by changing one or both of the intermediate gear reductions but maintaining constant speed, 210 R.P.M., of the driving pulley. Thus higher pressures at relatively reduced tonnage are possible when desired.

The symmetrical design of the press makes right and left-hand drives possible to suit local conditions.

For speeds up to 15 R.P.M. of the rolls and maintaining a pulley speed of 210 R.P.M., which conditions are suitable for producing 15 tons of anthracite briquettes per hour. The roll speed and columnar feed should be varied to suit the material being handled and the pressure desired to avoid overloads.

5′—0″ = height over all.
6′—4½″ = length over all when using a 42″ dia. pulley.
9′—0″ = preferred width when using a 42″ x 10″ pulley with clutch and outboard bearing on the side of the press adjoining the roll gears, or 8′—4½″ minimum.
8′—4½″ = width when using a 42″ x 10″ pulley with clutch and outboard bearing on the side of the press opposite to the roll gears.

The Briquettes.

The shape of briquette turned out by this press may be described as that shape formed by two equal size pyramids with square bases coincident with apices and corners rounded off.

The press can be used on practically all fine materials where small briquettes are desirable. Like all tangential presses, it should, in nearly all cases, be preceded by mixing or macerating devices.

The laboratory report of the tests made on this press is quoted herewith:

"Peat contained 35 per cent of moisture was masticated hot and rolled on a Universal Press. Good briquettes were obtained. On drying, a marked shrinkage occurred together with the hardening of the briquettes. The briquettes had several minute cracks, but were very good and would stand a drop from considerable heights."

As a result of this experiment the Peat Products Corporation have set up a press at their bog at Eaton Rapids, Michigan, and are turning out a good grade of peat briquette at the present time, which they were recently selling at good prices in the neighborhood of Grand Rapids, Michigan, and vicinity. The process is exceedingly simple, consisting of passing the air-dried peat—in this case containing about 35 per cent of moisture—directly into the Universal press and, subsequently, air drying the briquettes.

Physical and Chemical Characteristics.

It is certain that a change in the peat structure is caused by the successive linear pressures produced by the tangential action of the press, and that the water is thrown from its collodial condition in somewhat the same manner claimed for the Ekenberg process. At all events the peat, which has nearly reached its limits of air

drying at 35 per cent, goes through a secondary drying after it is in the briquette form and that is accompanied by extreme hardening as well as shrinking. In the shrinking the relative proportions of the briquette are preserved. The result is a hard shoveling fuel, as convenient to handle as coal, with an excellent radiating heat value.

It is customary to appraise fuels in accordance with their B. t. u. content, and, on this basis, the peat briquette mentioned would be worth 67 per cent of coal prices. Some have maintained, and the writer among them, that the regular form of all kinds of briquetted fuel and the nature of its combustion results in a radiating or heat throwing power which, for stove or hearth use at least, gives the briquette a value far beyond what its B.t.u. content would indicate. This is especially true of the peat briquette and, in addition, the fertilizer value of the ash must be considered. So, it might not be out of line to anticipate a selling price for the peat briquette equivalent to the best coal in the district. It is quite possible that the hardening and intense binding effect produced during the drying and shrinking of these roll press briquettes, is due, partially at least, to hydrolysis of cellulose, as is the case in the drying and shrinking of machine peat. Certainly in this instance it occurs to a more pronounced degree. The briquettes as they come from the press are weak and soggy; they must be spread out to dry. In drying they shrink from a 2 inch square edge to 1 3-8 inches. When coming from the press they are not weatherproof, but they become weatherproof with time. The writer believes that this phenomenon is partly due to the action of combined nitrogen in the peat on the bitumen in the peat, which would normally make that bitumen soluble in the water. After the evaporation of the ammonia, the bitumen would return to its normal insoluble state. At least it may be safely assumed that some such action occurs to assist the binding quality and weatherproofing of the hydrolized peat that holds the particles together.

It would seem that for the American market at least, where a shoveling fuel is considered absolutely necessary, that the roll press briquette made in so simple a manner as the above, will come into its own in districts but sparsely supplied with coal—as in New England and the Northwest. It may very well be that the future of peat fuel in America depends upon a proper combination of a pulping machine, like the Anrep, and a roll press like

the Universal. It is certain that the water cannot be pressed out by hydraulic presses, that artificial drying is very expensive, and that the simplest methods of drying and pressing must be adapted. It is at present hard to find anything simpler or better adapted to the people it is to serve than the above method.

THE IMPROVEMENT OF PEATY SOILS.[1]

PART I.—THE TRUE PEATS.

By E. J. Russell, D.Sc., F.R.S.,
Director of the Rothamsted Experimental Station.

There are three types of peat soils in England, differing markedly from one another, and presenting entirely different possibilities of improvement. They are:

(1) Fen soils, found in the eastern counties: Cambridge, the Isle of Ely, Norfolk, Huntingdon, etc.

(2) Low-lying peat soils, found in Lincolnshire and in the west, such as the Carr soils of Lincolnshire, Nottinghamshire, the peats of Chat Moss, near Manchester, and other Cheshire mosses.

(3) High-lying peat, found in the west and north, *e.g.*, Dartmoor, the Pennine chain and its outliers, Hambledon, etc.

The fen soils are distinguished by the fact that they are not strongly acid, often indeed not acid at all; they are very tractable and are practically all in cultivation. Drainage is the chief requisite; when this is done the land becomes very fertile. There is little now left for the improver to do, excepting after a disaster like the breaking of a bank by the Little Ouse in the Southery Fen, Feltwell, on 3rd January, 1918, when 20,000 acres were badly damaged. A few wastes still survive. One of these occurs in Wood Walton Fen, near Ramsey St. Mary's, Hunts. Part of the fen is deliberately kept as a sanctuary for wild life. The rest, however, is agricultural land, but as the lower part is liable to flood it has been left uncultivated and is now a dense thicket of birch and willow; some had been cleared by a previous tenant but was allowed to become direlict and covered with couch, and in places by rushes. The management of the land is now in the hands of Mr. A. Lancaster Smith, and his reclamation methods are described in *Country Life*.[2] Briefly the method is to raise the banks so as to keep out flood water, to break up the land with tractors, and then to grow potatoes, buckwheat, etc. Fen soils benefit by additions of clay but not of sand; they do not as a rule respond to lime—though this particular district is an exception—

[1]Journal of the Ministry of Agriculture, London, England, March, 1921.
[2]Country Life, 7 September, 1917, p 187, and 21 June, 1919 p 766.

the most striking effects are produced by superphosphate, but not by basic slag. Some of the fen soils—including this one—respond to potash and also to nitrate of soda and sulphate of ammonia; others do not, however, on the so-called clay fen in the western side of the region.

Any farmer in the fens having small derelict areas in his possession would be fully justified in reclamation. Some of the Cumberland peats seem to resemble the fen soils in that they do not markedly respond to lime; they benefit, however, by dressings of slag.

The low-lying Peats.—Like the fen soils, these require drainage before anything can be done, but in addition they require large dressings of lime as, unlike the fen soils, they are strongly acid. When the work is properly carried out reclamation is quite a feasible and often a profitable process. Two general methods are in use:—

(1) The land having been drained, ameliorating substances (such as lime, artificial manures, etc.) are added and the peat is cultivated as if it were normal soil.

(2) The peat is removed and sold, and if the climate allows, the underlying formation is drained if necessary and then either—

(*a*) Ploughed up;

(*b*) Covered with town refuse and then cultivated; or

(*c*) Warped, *i.e.*, systematically flooded with tidal water carrying silt till several feet of soil have been formed; this is possible only in a few areas, *e.g.*, Lincolnshire, lying below high-water level.

The first of these methods is adopted in Ireland and on the Continent; it is much investigated at the Experimental Stations at Jönköping (Sweden), Bremen (Prussia), Munich and at Arnheim (Holland). It has been tried at Wadfast Moor, Cornwall.

Some of the Irish attempts have been described in the Journal of the Irish Department of Agriculture for 1915 by Mr. Duncan. The problem is complicated by the existence of more than one kind of peat, *e.g.*, potash sometimes produces marked effects, and sometimes does not; before any important reclamation could be carried out it is necessary to make a careful study of the kinds of peat concerned. Two Scotch reclamations are described in the Highland Society's Transactions for 1899.[1]

[1]Vol. 11, p. 150.

The Jönköping experiments are carried out under the able direction of Professor von Feilitzen, and are described in the reports issued by the Swedish Society for Moor Culture.[1]

The Belgian and Dutch methods consist in drainage, then addition of sand,[2] followed by deep ploughing and liming. The work is done by land reclamation companies[3] who acquire considerable experience and achieve much success. An interesting feature is the addition of farmyard manure. At first sight this addition of organic matter to a peat soil looks like "carrying coals to Newcastle," but it is founded on successful practice. In Holland it is not unusual to make up a heap of farmyard manure, soil, waste vegetable matter, etc., and leave it for some time to "ripen", and then spread it on the soil at the rate of about 2 tons per acre. The idea is to introduce the necessary soil bacteria into the peat which normally contains quite a different micro-organic flora. After this has been done a plant of clover is said to be obtained with more certainty than before. It is not clear that other crops benefit directly, but of course, any improvement in the clover reacts on the crops coming afterwards.

The second type of method—the removal of the peat and treatment of the underlying soil—has proved more popular in England because the high market-value of peat helps to set off some of the capital cost of the work. The removal and sale of peat is perfectly sound in principle. Peat is an asset of considerable value, but it is essentially a wasting asset; it disappears at a measurable rate after the drainage necessary now-a-days. Under modern conditions peat cannot be conserved for future generations, and we are therefore justified in using it ourselves even if the process be somewhat wasteful.

The best known example is the reclamation of Chat Moss, near Manchester, on which ashpit and other city refuse was carried after the peat was removed. The estate was taken over by the Corporation of Manchester in 1895, and after some adjustments consisted of 2,536½ acres, for which £130,969 was paid. £60,215 was spent on erecting and laying out farms, roads, light railways, etc. The rents during 1915 amounted to £5,313. The very similar Carrington Estate of 1,100 acres was purchased in 1886 for £39,166: nearly £44,000 was spent in drainage, light railways,

[1]Abstracts appear from time to time in the Jour. Board Agric.
[2]Several attempts have been made to find out what the sand does.
[3]Such as the Nederlandscheheide Maatschappy, Arnheim.

roads, farm buildings, etc., making the total cost £83,142. The rents during 1915 amounted to £2,110. Thus the increase in agricultural value is not sufficient to carry the whole cost of the improvements: the City, however, gains in other directions in that the areas provide convenient dumping places for its refuse, whilst there is the possiblity of further income from the sale of peat.

Another area worked on the same principle is near Edinburgh, where city refuse is carted out and then used for farm land. Again the increased agricultural value does not pay the whole of the cost of the reclamation, the city having to pay for the advantages of having a dump for refuse, and a place where relief works can be carried out.

Carr Soils.—These form an interesting example of peat soils that present some difficulty in management. The name is given to low marshy peat land containing the remains of old trees, birch, alder, etc. The word "Carr" is of Scandinavian origin denoting a marsh. In Nottinghamshire the "Carr" forms a strip of land about 2 miles wide and 15 miles long, lying south of the river Idle and north of the Trias escarpment on which stand Everton, Gringley, etc. The top 9 inches of peat appear to be formed from grass and rushes; the lower 9 inches to 15 inches from decayed wood. There can be little doubt that the upper layer was much thicker when the land was first drained during the Napoleonic Wars, and the original venturers were well repaid by the bounteous crops of rape and oats. The cropping seems to have been of an exhausting nature, and it was made worse by the paring and burning which accompanied it.[1] With the disappearance of this layer of grass and rush peat through shrinkage and oxidation the lower layer of wood peat has been brought into prominence, and is found not to be very satisfactory material. From the mechanical point of view the tree stumps and roots are a great nuisance, holding up the plough, sometimes even throwing it out of the ground. Regarded chemically, peat formed from wood is of little promise, comparing very unfavorably with that formed from grass or rushes. Without definite trial there could be no certainty that methods successful on a fen would answer on the "Carr." There appears to be evidence of definite plant poisons in the peat, oats and mustard having failed unaccountably.[2]

[1]R. W. Corringham, J. Roy. Ag. Soc. 1845. Vol. 6 p. 40.
[2]E. E. Stokes, J. Bd. Agric. 1913, 20, 672.

The analysis of the soil is as follows:—

	(*Upper layer*). (Mid. Agric. Coll.)
Organic matter (loss on ignition)	57.8
Nitrogen	2.11
Potash	0.60
Lime	1.06
Magnesia	0.28
Phosphoric acid	0.26

Thirty years ago there was still a certain amount of arable cultivation, but it has now declined and the land remains in poor grass, largely Yorkshire fog, which becomes badly infested with rushes. It affords a certain amount of grazing for bullocks and pit ponies.

The land could probably be converted into arable, but two steps would seem to be involved in its reclamation:—

(1) Improved arrangements for drawing off the water, the level of which in the soil is now somewhat too high owing to the shrinkage of the peat.

(2) More body seems to be needed in the soil, especially in the "wood" peat.

The soil is underlain by clay, and the most hopeful method of improvement for the arable land would appear to be the claying process carried out successfully on the "clay" fen in the Isle of Ely. This involves the digging of trenches down to the clay which can then be thrown out; but the peat is light and not deep. On the road across the "Carr", which is bordered by a deep drain, and therefore presumably received some of the clay thrown out during the excavation, there is a considerable development of clover and a vastly better herbage than is afforded by the mass of Holcus and rushes in the main part of the "Carr."

(3) Lime and fertilizers would certainly be needed.

The programme probably looks more formidable than it really is, and the position of the land promises a return.

It is possible of course that the area could be warped, as is done on the other side of the river in the Hatfield Chace and Thorne Moor district, and this would be a final and satisfactory solution. This, however, is an engineering problem which the writer is not competent to discuss.

As an alternative, the land could be used for permanent grass, liberally treated with phosphate, mown occasionally to keep down rushes, and periodically re-seeded when Holcus has become too prominent. Probably the best system would be a combination of the two; using long leys with intervening arable periods.

High-lying Peats.—These present the most difficult case of all because the high rainfall intensifies their naturally wet character, and the coldness makes agriculture very difficult.

Many attempts have been made to reclaim the high lying peats, but few have met with success. Mr. Pell, in the Journal of the Royal Agricultural Society for 1887, records a case where £24 7s. 6d. spent per acre in the reclamation led to an increased annual rental of only 3s. 2d.

The most interesting case is that of Dartmoor. Somewhere about 1780, Mr. Gullet began reclamation on the farm which is now known as Prince Hall, and Mr. Bray began at Bairdown Farm. Gullet was succeeded by Mr. Justice Buller, who, we are informed by Robert Fraser in his Survey of 1794, "finding that his health was greatly improved by the purity of the air," settled on the moor at Prince Hall and started farming; his successor, G. W. Fowler, continued the work from 1846 onwards. But the great 18th century improver of Dartmoor was Sir Thomas Tyrwhitt, of Princetown, an account of whom was published by Mr. J. Bocking-Rowe in the Devon Association Proceedings for 1905.[1] In 1854, Henry Tanner, estate agent of Exeter, published a prize essay on "The Cultivation of Dartmoor as a source of employment for the unemployed population of the district," and claimed that oats, vetches, clovers, grasses, rape, turnips and swedes could all be grown successfully. He was very hopeful about reclaiming the moor.

An account of the old Prison Farm is given by Mr. F. Punchard, in the Journal of the Royal Agricultural Society for 1890,[2] showing that land previously rush-covered was then carrying a bullock per acre in summer, while distinctly good results were obtained on arable land. The present day condition of the farm hardly comes up to Mr. Punchard's account, no doubt because of the difference in the amount of labor available.

The land was first trenched, then drained, sown with rape which was fed off with sheep, followed by swedes fed off with sheep also

[1]Other information is contained in the notes to "Dartmoor," a poem by N. T. Carrington, (1826).

[2]Series 3. Vol. 1, p 534.

receiving cake and corn, then followed 2 or 3 years of seeds, then barley with which was sown the following mixture of grasses, which were intended to remain permanently: perennial rye 8 lbs. Italian rye 4 lb., cocksfoot 3 lb., meadow grass, timothy and meadow foxtail 2 lb. each, fescue 1 lb., cowgrass, trefoil and white clover 3 lb. each, alsike 1 lb.; in all, 34-36 lb. per acre.

During the War a considerabe scheme was undertaken by the Duchy of Cornwall, under the supervision of Mr. H. Vendelmans, a Belgian expert.

The area under treatment lies to the east of Princetown. It stands at an altitude ranging from 900 ft. to 1,250 ft. above sea level, and it has a rainfall 85 to 95 inches. While somewhat warmer than the northern moors it is distinctly cold in spring and autumn. The peat is strongly acid and consists of two layers; the upper about 4 inches in thickness formed of partially decayed vegetation (the heather breaking down more easily and the sedges taking longer); the whole however is difficult to plough; the lower layer is composed of black decomposed material. Below this again comes a dark brown or chocolate colored layer of earth several inches in thickness, probably at one time the original surface soil until it become covered up by a deposit of peat. It is gritty and stony, but usually it has not formed a continuous hard layer of rock or "pan." It must, however, be broken so as to allow full liberty to plant roots. Underneath lies a considerable depth of reddish brown or yellowish earth with occasional patches of white clay. This is so gritty and contains so many pebbles that it is not likely to prove hopelessly retentive of water; further, it is deep in many places. The lowest layer of all is the granite, from which the whole formation arises. Much of the granite is light colored. It disintegrates very readily in exposure to weather as is well seen in the little quarry near Two Bridges at the junction of the Tavistock and Princetown Roads.

Assuming the land to remain in arable cultivation the 9 inches of peat now covering it would gradually oxidize and disappear, bringing more and more into prominence this old surface soil; its composition is as follows:—

	Black or chocolate colored layer (probably original surface soil), 9 in. to 15 in. from present surface			Reddish earth (original subsoil underlying black layer), 15 in. to 24 in. from present surface.		
	1	2	3 (8 in.-11 in.)	1	2	3
Fine gravel	17.1	7.9	9.2	18.2	13.8	10.8
Coarse sand	16.5	19.5	32.1	17.1	16.4	27.0
Fine sand	23.3	24.1	20.9	19.5	18.5	20.9
Silt	14.7	18.4	11.8	17.0	19.4	17.1
Fine silt	9.7	11.5	10.5	11.6	10.6	7.7
Clay	2.4	2.8	2 6	4.4	7.4	4.6
Loss on ignition	12.4	12.7	10.3	7.8	9.8	8.4
Phosphoric acid (P_2O_5) Total	0 03	0.05	0.03	0 04	0.06	0.2
Potash (K_2O) Total	0.23	0.23	0.28	0.41	0.41	0.44
Nitrogen	0 22	0.26	0.22	0.11	0.15	0.12
Carbonates	Nil	Nil	Trace	Nil	Nil	Trace

This new soil should not prove difficult to cultivate if it were not for the high rainfall, but its fine silt would tend to make it sticky. It is very deficient in plant nutrients, and like the present peat layer would need lime, phosphates, nitrogen and potash; drainage would also be essential.

In general the plan of reclamation proposed by Mr. Vendelmans follows the lines successfully adopted in the low lying peats of Belgium and Holland, viz., deep ploughing followed by the addition of sand. It is not necessary, however, to add sand on Dartmoor as the peat is only about 12 inches thick, and is underlain by a layer of sand which is brought up to the surface during the ploughing.

The first ploughing is very troublesome owing to the uneven nature of the surface. In some places the entire plough fell into a hole 3 ft. deep. Naturally it was impossible to do good work in these circumstances, and a good ploughman accustomed to turn a neat straight furrow would stand aghast at the roughness of some of the first attempts. After this ploughing, the land was left bare for a year; it was then harrowed, limed and ploughed over again. This time much better looking work can be done, and the land now begins to take on a normal appearance.

The land is cut up into fields of about 10 acres, between each pair of which a ditch is ploughed. Between successive pairs it was intended to make a plantation 25 yards wide to protect the crops from damage by high winds.

The rotation proposed by Mr. Vendelmans had five courses:—

Buckwheat,
Winter oats,
Clover,
Oats for hay or silage,
Roots.

All these crops were sucessfully grown on the trial plots in 1916. The buckwheat was to be sown in May, and cut in August in time to drill the winter oats in September; clover was then to be sown in April. The oats for hay or silage were to be cut while still green, and harvested by the ordinary Belgian method, or made into stack silage as is done by Baron Peers of Bruges.

The field trials of 1916 brought out several important points. The great need of lime was demonstrated; the crops having failed completely on most of the plots from which it was withheld. Even 1 ton of lime per acre was insufficient for oats, though it proved enough for turnips and potatoes. Cabbage and kohl-rabi failed except where potash was supplied; clover also showed marked need for this fertilizer. Phosphates had striking effects on turnips where lime was present, but not otherwise; they also acted well on oats. With these results established it is not difficult to draw up a scheme of manuring suited to the rotation.

The subsequent years, however, have shown that the original scheme needs modification. A recent examination by the writer showed that much of the vegetable matter was still undecomposed, especially the roots and stalks of the common sedge, locally called Carnation grass (probably *Carex panicea*).[1] But the worst feature is the high rainfall, which is between 80 and 90 inches per annum, and is apt to be accompanied by high winds. One day during my visit I found it impossible to walk over the arable land, although accustomed to rough weather and well protected against the rain. For days afterwards no horses could get on to the land. Oats therefore had not been a success; it had been a sheer impossibility to sow them in time; nor indeed could they have stood up against the wind and rain even if they had been sown fairly early.

[1]In absence of flowers and seeds identification was impossible.

The root crops on the other hand—swedes, turnips, rape—were looking well *where lime had been liberally used and could still be found on the surface.* Some of the roots were very fine and the crop was probably about 20 tons per acre; but they were a complete failure on two sections where the lime had been ploughed in, and so carried below the surface.

Cabbage might have succeeded, but they were liable to be blown out of the ground. Finger and toe is unknown in any of the crops.

Grass also does well, and the sown grasses are so marked an improvement on the wild vegetation that the cost of the breaking up will no doubt be repaid by the increased value of the herbage, even without taking any account of the arable crops obtained. Cocksfoot is growing very vigorously, rye grass also persists, and there is a fair take of timothy.

The reclamation must be regarded as an experiment, the results of which will not be certain for some years to come. There is no similar case elsewhere so far as I know. The lines appear to be sound. If the reclamation succeeds it will open up considerable possibilities of future developments; and if it fails after an honest attempt to carry it through, it will have demonstrated the fundamental difficulty of cropping at high altitudes.

NEWS OF THE DOMESTIC INDUSTRY.

Illinois.

Peat fuel deposits were discovered in October on tracts of land owned by John Miller and others in Chicago. It is reported that the residents of the locality are producing their own fuel with slanes.

Michigan.

According to the press, C. A. Wilmarth, of the Wilmarth Co., Appleton, Wisconsin, is planning to erect a peat fertilizer plant at Tecumseh, Michigan. It is stated that there is a deposit of good quality southwest of this town.

Minnesota.

Minnesota will have an independent fuel supply and will not have to depend so much on coal operators of the central or eastern states when its vast peat deposits are developed, according to Twin City business men and railroad officials.

Already a Minneapolis firm is marketing prepared peat, which is being used for furnace and heating purposes.

The peat plant at Corona is turning out peat in large quantities. Additional capital and enterprises are all that is needed to further develop peat projects.—*Mankato Free Press, October* 1921.

State Officials Exhibit Products at Fair.

The use of peat for fuel was demonstrated at the State Fair last fall. The exhibit was prepared by F. A. Wildes, State Superintendent of Mines, in co-operation with the School of Mines.

J. H. Hay, Deputy Commissioner of Agriculture, states that the possibilities of peat as a substitute for coal are just beginning to be realized, and that there will be a large peat industry developed in Minnesota within the next few years.

Business Men Visit Carlton Bogs.

Thirty business men and railroad officials recently visited the peat bogs of Carlton County. At Corona peat digging machines are engaged in fuel manufacture. Much interest was shown in the prospects for the development of peat for fuel, according to the St. Paul Association of Business Men, who state that the adaptation of peat to commercial use would mean a great deal to the industrial progress of the State.

New Companies Formed.

The Universal Investment Company, of Minneapolis, with a capital of $50,000, filed articles of incorporation with Mike Holm, the secretary of state, recently. M. A. Kurstin is president, Felix Moses, vice president, and L. L. Swarthe, secretary and treasurer.

The Standard Peat & Fuel Company, of Duluth, with a capital of $100,000, also incorporated to manufacture peat products for fuel purposes. Irwin K. Johnsted is president and treasurer, M. Seppanen, vice president, and D. Gotken, secretary.

North Carolina.

Large Deposits of Peat Destroyed by Fire.

Hundreds of acres of peat soil in the neighborhood of Moyock, N. C., have been destroyed by fires during the past several weeks, according to reports.

The flames in many places burned down to the clay subsoil, ten feet below the surface. Farmers hastily gathered their crops and attempted to save their lands by damming Shingle Landing River so as to flood the region, but low water due to the long drouth rendered their efforts futile.

The fires advanced to within a mile of the village of Moyock.. The burned section will be useless for cultivation and probably will become one of the numerous lakes which dot the Dismal Swamp.

NEWS OF THE INDUSTRY IN FOREIGN COUNTRIES.

Ireland.

Experiment With Irish Peat.

A report of an interesting experiment which indicates great possibilities of the economic development by Ireland of her immense resources of bog peat, has been published by the Department of Scientific and Industrial Rsearch, in the form of a technical paper, entitled "The Carbonization of Peat in Vertical Gas Retorts." The pamphlet gives results of experiments carried out by the Fuel Research Board with peat cut in the bog at Turraun and carbonized at H. M. Fuel Research Station. Certain difficulties were experienced owing to the dust formed when breaking up the peat blocks, as well as from other causes, but these, it was said, could be overcome, and the conclusion reached is that the peat blocks lend themselves admirably, after suitable treatment, to carbonization, while the resultant charcoal is an ideal fuel for suction gas producers. From each ton of peat treated there was produced for disposal 26 therms (7.940 cubic feet) of gas of 325 B. t. u., as well as 12.6 gallons of tar, 95½ gallons of liquor of 3.6 ounces strength per ton and 5.4 cwt. of charcoal. The gas, though giving a satisfactory flame, was of only slight luminosity, and a heavy, sickly odor on combustion came from it. The liquor was analyzed, and methyl alcohol, acetone and acetic acid produced, while the tar contained a high percentage of paraffin wax.—*New York Commercial, November 4, 1921.*

Netherlands.

The following letter recently received from the Netherlands contains a description of a peat colony and indicates the condition of the peat industry in that country:

Klazienaveen, Holland.
October 7, 1921.

To the American Peat Society:

Description of Dutch Peat Colony.

I take the liberty of setting forth herewith a photograph of a small model peat colony that I make from my peat plots.

Perhaps you will remember my name, which appeared in the fourth edition of your 1915 journal. At that time I gave a description of the peat industry in the town of Emmen, Holland. Your quarterly journal was regularly sent to me, but during the war I did not receive it. In this letter I will give a brief description of the peat plant here at present.

My miniature peat colony is 8 x 24 x 40 inches in size. It gives a true picture of the development of a peat colony in Holland. I can make them in any size at a price ranging from $30.00 upward, safely packed for shipment at Rotterdam. The weight is about 25 pounds for the usual size.

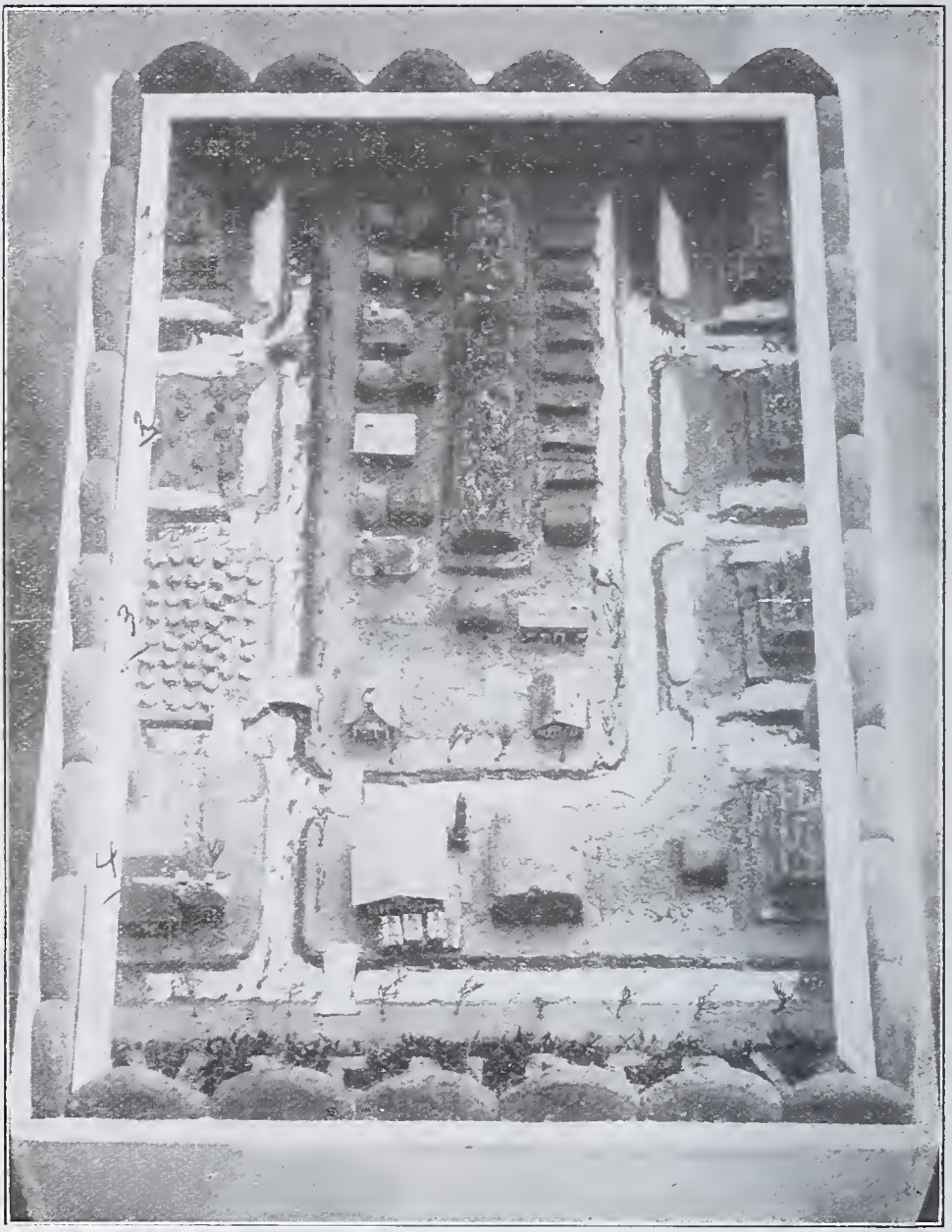
On the left side of the photograph from top to bottom the following appear:

1. Peat field on cut.
2. Field from which peat has been removed.
3. Cultivated section from which peat has been removed. Note the wheelbarrows of sand.
4. Cultivated field. Notice the farm at one corner.

On the right side of the cut are four peat fields. Between the two main canals is the center of the colony. You see there a small strip of blooming heath (Heide) on top, and on each side houses, piles of peat and drying rings. There are eight buildings including the moss litter mill with bales in front. The main and side canals are filled and have green borders. There are also trees along the roads. The name of the plant is "Veendery." The plant at the bottom of the photograph is surrounded with a green mat. The white box is covered with glass.

Peat Industry in Province of Drente, Holland, in 1921.

During the last years of the war and up to 1921 the peat industry in Holland was more active than ever before. Except for the



Model Peat Colony in Holland.

distribution of food, the inhabitants of the Dutch peat colonies did not feel much of the miseries of war.

As in the case of all fuel, peat was distributed throughout all of Holland at maximum prices fixed by the Government. Wages of workmen were high but the price of peat was likewise very high. The best peat for mills was sold at 3.50 florins per meter at the field and the freight from the Drente peat fields to Amsterdam was also 3.50 florins per meter. The cost was therefore 7 florins per cubic meter on board ship at Amsterdam. These are prices of common mill peat. The best heavy, hard kinds for stove and household use were much higher in price. Of course production was stimulated to the utmost.

Very suddenly in the early spring of 1921 the drop came. There was absolutely no call for peat, largely on account of the critical conditions throughout the country. All work was stopped at the peat plants and 75 per cent of the peat harvest of 1920 was standing in the fields. In April and May, 1921, there were 7,000 unemployed peat workers in Emmen. Little new season work was done at 65 to 80 per cent of the wage tariff of 1920.

The best mill peat is now sold at 2 florins per cubic meter and freights are one-third of the rate charged in 1920. All the peat digging for 1921 was done early in the year and the Government is obliged to look for work for all the men. The Government offers to subsidize at the rate of 450 florins per Ha. for cultivating dalgrounds. New roads and canals have been built, but the Dutch peat colonies have a bad winter ahead and peat prices will go down further in spite of the large peat trust that has just been formed.

(Signed) CHRISTIAN W. DICK.

PROCEEDINGS OF THE EXECUTIVE COMMITTEE.

By Chas. Knap.

Freight Rate Reductions.

Some progress has been made by the Executive Committee in the matter of freight rate reductions on humus. As previously stated in the proceedings, the proposed reductions were presented to the Trunk Line Association with the request that humus be given the same rate as manure. It is gratifying to report that the Lehigh and Hudson and Delaware, Lackawanna & Western railroads have agreed to a 20 per cent reduction and an equalization of rates from all humus producing points.

Chief Geologist White Elected to Honorary Membership.

At a recent meeting of the Executive Committee it was decided to offer honorary membership in the society to Dr. David White, Chief Geologist of the United States Geological Survey, who attended the last annual convention and showed much interest in peat and in the society. It is pleasing to report that the offer was accepted.

Crowley Takes Advertising Contract.

An agreement has been made with Crowley, "the magazine man," 511 East 164th St., New York City, under which he will advertise the Journal of the American Peat Society in his list of Scientific and trade publications that is said to have a circulation of 3 million. The cost to the society, which is relatively low, will be paid out of the subscriptions he obtains. His booklet contains a list of business, class, professional, and technical publications, with a brief, comprehensive description of the field they cover. He will be glad to send members of the society a free copy of his next magazine review.

ABSTRACTS OF PATENTS.

Process of Treating Peat and Similar Substances.

By Fred T. Dow.

This invention relates to a novel process for treating peat and similar substances which contain water for the purpose of facilitating the extraction of the moisture therefrom preparatory to subsequent treatment of the material for the purpose of briquetting it.

The process is especially adapted for use in treating peat, and for this reason I will describe it as it would be thus used, although it is equally applicable for treating other substances, either animal, vegetable or mineral, for the purpose of extracting moisture therefrom.

In applying my process to the treatment of peat, I first drain the water from the peat by the action of gravity. This may be done in various ways depending on the location and character of the peat bog. If the bog is one which can be drained the easiest way of draining the water from the peat by gravity would be to drain the bog. If, on the other hand, the bog is one which cannot be readily drained, then the peat may be removed from the bog and deposited on high ground in a position so that the water will drain therefrom by gravity. After the water has been allowed to drain from the peat by gravity for a suitable length of time, I propose to force air or other drying medium under pressure through the drained peat mass while in its normal uncompressed condition. This forcing of air or other drying medium through the peat mass operates both to loosen up the latter so that any free water which has been confined therein may more readily drain out, and to cause an evaporation of moisture therefrom.

After the air or other drying medium has been forced through the peat mass for an appropriate length of time, I then propose to draw air or some other suitable drying medium through the loosened peat mass by suction. This operation results in further extracting moisture from the mass. After these steps have been continued alternately for a suitable length of time the free water will be entirely removed from the peat mass and the latter will be partially dried and it will then be in condition to be ground or macerated or otherwise treated preparatory to being dried and briquetted.

The drying medium may be first forced through the peat mass thereby loosening it up and then drawn by suction through the loosened mass in any suitable way.—U. S. Patent 1,393,435.

Methods and Means for Removing Water from Peat.

By Abraham ten Bosch.

The present invention relates to a method of and means for freeing peat of water by expression after the application of heat thereto.

It is a well known fact that fresh peat usually containing 85 per cent of liquid behaves like a liquid if subjected to pressure in an inclosed space. In other words the water absorbed in the peat cannot be removed from same by pressure exclusively.

The Swede Ekenberg deserves the merit of having found that water can be removed from peat by pressure if heat is applied to same.

The fact that notwithstanding said invention the method proposed by Ekenberg has not come into commercial use, is due to the fact that the process is not sufficiently efficient to be practical, in spite of all improvements proposed and effected by Ekenberg and others.

The present invention relates to a method of this kind for removing water from peat in which the heat is applied to the fresh mass in a manner so as to increase the efficiency. The invention provides for the possibility of efficiently reclaiming earth containing peat and thus solves the question of fuel consumption independent of coal mines.

The principle of the invention is based on the fact that from the moment the temperature of the peat is raised and pressure applied to same, it tends to release the liquid absorbed. This tendency increases as the temperature and pressure rise. This behavior appears to be caused by part of the vegetable cells of which the peat is composed giving way under the internal pressure induced by a comparatively little rise in temperature. The characteristic difference of this method as against the process of Ekenberg in principle consists in that the latter, while subjecting the peat to great pressure in inclosed horizontal reservoirs, raises its temperature above the point at which wet-carbonization is initiated, and then conveys the peat to presses for squeezing the water out of same.

According to one feature of the present invention the peat initially is subjected to pressure exerted by its own weight in open towers or columns, whereupon, under application of an artificial pressure, in inclosed spaces the temperature of the peat is gradually raised. During said process the peat initially is pre-heated by the warm discharge water obtained from other towers and thereby frees part of its water and then is heated to the required temperature by means of steam applied. Heating of the peat, however, is preferably not carried as far as the wet-carbonizing temperature.

According to a second feature of the invention the liquid expressed during the gradual increase of temperature and pressure is supplied to a fresh mass of peat contained in a second vertical column or tower, while the liquid is discharged from the latter is conveyed to a third and if need be afterward to still another column of fresh peat. As indicated above the fresh peat is always first mixed with the warm liquid pressed from a pre-heated mass of peat.

A third feature consists in that the peat after having been freed from water to a sufficient degree, is removed from the tower by means of the pressure prevailing in said tower. Then the tower in open condition is filled again and the mass operated upon by the warm discharge liquid recovered from a third or following tower.

The above described method allows for continuous operation. All undue heat losses are obviated within practically possible limits and thus an exceedingly high degree of efficiency obtained.

The invention further relates to an arrangement for carrying out the method described.—U. S. Patent 1, 369, 611.

Treatment of Peat.

By R Graeffe and O. Hasse.

A building-material with heat and sound-insulating properties is prepared by macerating 10 parts of peat in boiling water, adding 4 parts of coal-tar pitch heated to 200° C., and boiling until the pitch is thoroughly incorporated with the peat. For inferior material the preliminary maceration of the peat may be omitted. The product may be either pressed into slabs, etc., while moist at a temperature of 100° C., or it may be dried and subsequently moistened and pressed. The material may be roasted or carbonized at temperature above 150° C. either before or during pressing. For certain purposes, clay mash with or without kieselguhr, cement, mag-

nesite, lime, or plaster of paris may be added.—British Patent 166, 856.

Briquetting Peat.

By R. Klasson and V. Kirpotschnikoff.

In a process of making peat briquettes, the peat is washed away from the walls of the peat bog or pit and collected in a deep part of such bog or pit, whence it is pumped by a turbine pump, constructed to act also as a crushing-machine, and delivered by piping to a drying-field, whereon the peat is spread out in a thin layer to be cut into blocks by known means. The pump, with its accessories, is suspended from a crane running upon rails and is connected by flexible connections to the piping, so that the crane can travel along the rails and the pump can be raised or lowered without disturbing the piping; or the pump, with its accessories, may be suspended by means of a pulley from a block adapted to travel along a rope stretched between two supports near the sides of the peat bog or pit. The pipe is made up of sections which can be removed singly as the layer of peat spreads over the field and can be put together again to form a pipe for discharging peat mud upon an adjacent field. A multi-stage turbine pump may be employed. Each stage consists of a guide portion which is contracted upwardly and carries vanes, and a delivery portion, which widens upwardly and encloses a vane-wheel mounted upon a central shaft. The lowest stage of the pump is preferably formed with an enlarged inlet passage obtained by using a cylindrical portion or a conical portion with its wider end downwards. The hub of each vane-wheel conforms to the internal form of its corresponding portion so that the passage for the peat pulp is approximately constant throughout the pump. Roots and other hard substances in the peat are prevented from entering the pump by a vane-wheel on the lower end of shaft. A blade preferably having a serrated cutting edge co-acting with the sharp edges of the vane-wheel, is secured by means of a plate to the lowest portion of the pump. The number of turbine stages may be reduced to the smallest necessary to effect the grinding and crushing of the peat; if this number of stages is too small to generate the necessary delivery pressure of the peat pulp, the extra pressure required can be obtained by using another pumping-apparatus. —British Patent 166, 576.

CURRENT COMMENT.

President Robinson Sets Good Example.

Of the 76 new members added to the American Peat Society during the fiscal year ended June 30, 1921, President Myron W. Robinson, of the Crex Carpet Co., 295 Fifth Avenue, New York City, secured 35 or almost 50 per cent. A membership campaign will be started by the editor in the near future and other members will be given an opportunity to emulate this excellent example.

Ranson Writes of Carbonic Acid Gas in Greenhouses.

St. Augustine, Fla.,
July 16, 1921.

To the American Peat Society:

In the Scientific American of Nov. 27, 1920, is a very interesting article showing the remarkable results obtained by the introtion of carbonic acid gas into green houses and the increased growth of all kinds of vegetation.

We are carried back in thought to the Carboniferous Age so well described in the works of Hugh Miller, when the club mosses, which now grow about the size of a man's thumb, then attained the height of our largest pine trees due to the excess of carbon dioxide in the atmosphere. Dr. Fr. Riedel has been carrying out his experiments in the neighborhood of the large iron furnaces on the lower Rhine, where the gas is easily collected. He introduces it first into the greenhouses and later carries it in perforated pipes out-of-doors in the soil. Not being situated near any large furnaces Dr. W. B. Guy of St. Augustine, Florida, has bred and introduced a carbon dioxide producing bacteria into peat soils prepared by my methods. I am inclined to think that many of the best results obtained by using a fermenting agent in peat such as dried blood, fish glue, and similar matter have been due as much to the carbon dioxide given off during the action of the bacteria as to the nitrogen formed by them. In any case it opens up a vast field for the student as a means of furnishing carbon to plants. As in many other cases no product of nature seems better fitted to serve as a suitable medium than properly prepared sterilized peat.

(Signed) Robert Ranson.

ADVERTISEMENTS

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The bibliographic and reporting service of the Revue de l'Ingenieur is the same as that which furnishes the index on all technical subjects.

The service is completed by a translation department.

Journal of the
American Peat Society

Vol. XV. APRIL 1922 No. 2

MEMBERSHIP CAMPAIGN TO BE CONTINUED.

JUNE 30 SET AS FINAL DATE FOR ANNOUNCING RESULTS.

That the membership campaign is yielding results is evident from the number of new applications that have been received since the first of the year. It was planned originally to publish a list of members who secured applications in this number of the Journal, but since there is still a large number of members, officers, and committeemen who have not yet submitted their quota or an alternative contribution, it has been decided to continue the campaign until June 30.

Every member who is seriously interested in peat owes it to himself, the society, and the industry to do his share in this effort to expand our activities and prestige.

In order to refresh the minds of members with the plan of the campaign and their obligations thereunder I am repeating it and appending a list of officers, members of the committee, and sub-chairmen showing their quotas of new memberships or suggested alternative contributions. A considerable number of persons on the list already have reported encouraging results.

The Executive Committee, to provide funds for the publication of the journal and to promote the wider use of peat, has determined to conduct a campaign for increased membership. The management of this campaign has been placed upon me. The duties of my gratuitous office as editor are already burdensome, but I am willing to undertake this task in furtherance of the society's welfare and of a cause in which I thoroughly believe. To fully inform the public of the commercial value of peat, to keep members posted on current scientific developments, and to con-

vince the users of its merits are the objects sought to be accomplished, and the active co-operation of all members is solicited.

The Executive Committee, sitting as a committee on increased membership, has enlistd the entire membership to secure new members. The peat regions have been divided into 13 districts and a sub-chairman has been appointed for each district. Each sub-chairman is expected to communicate with every member in his district and tell him that he has been delegated to secure and submit through the sub-chairman one new application. The quota of each sub-chairman, exclusive of applications obtained by members in his district, is five. Failing to secure one new application, each member is expected to remit $5.00. Failing to secure his own quota, each sub-chairman is expected to remit $25.00. Officers and members of the Executive Committee are expected to obtain ten new members or present their checks for $50.00. A letter outlining the plan in detail has been mailed to each officer, member of the Executive Committee, and sub-chairman. All funds and applications should be sent to the secretary.

A list of officers, members of the Executive Committee, district sub-chairman, and members will be published in a later edition of the journal. Opposite their names will be shown the quota of new memberships or alternative contributions allotted to each and the results that they have reported.

C. C. OSBON, Editor.

COMMERCIAL PRODUCTION AND UTILIZATION OF AIR-DRIED MACHINE PEAT FUEL.

By Ernest V. Moore, B. Sc.
Member Engineering Institute of Canada.

Introduction.

Peat can only be said to be produced commercially when it can be sold to the consumer at a price sufficiently above its total cost when delivered to him to show a fair return on the capital invested.

This statement mentions two factors common to most business transactions—selling price to the consumer and total cost when delivered to the consumer—and to discuss these two with any degree of thoroughness would require much more time than is available for this paper. The selling price will not be considered other than to state that it depends largely on the use for which the peat sold and upon local conditions. The fair market value may vary as much as two to one, depending on these two factors. Likewise the total cost when delivered to the consumer may vary. In the following remarks, to limit the field of discussion, air dried peat fuel for domestic consumption only is considered, and the consumer is an average householder living in a city less than 100 miles from the bog.

When a ton of peat is delivered to this man it is burdened with the following charges:

1. Profit of the retailer.
2. The retailer's overhead and delivery charges.
3. The cost of storage either in the retailer's yard, or at the peat plant, or possibly at both places.
4. The cost of transportation.
5. The cost of loading and unloading.
6. The wastage in the handling operations.
7. The manufacturer's profit.
8. The manufacturer's overhead.
9. The manufacturer's production cost.
10. Cost of the raw material.

It is evidently beyond the possibilities of a paper such as this

[1] Read before the Fifteenth Annual Convention of American Peat Society, Septmber 7-9, 1921, in New York City.

to discuss these charges in detail and all but No. 9 are mentioned principally to remind the hearer that even if production cost were entirely eliminated, the peat manufacturer still has a number of problems on his hands which must be taken care of in order that his venture may become profitable and therefore economic.

During the present period of readjustment when retailers have not altogether gotten away from ideas developed during the war, when wage scales and working conditions are changed from day to day, and freight rates are likely to be revised, it is not possible to say much that would be of value in connection with Items 1, 2 and 4. Items 3 and 5 depend largely on local conditions and the equipment installed to handle the fuel. We know that for the same number of heat units it takes between three and four times the storage capacity to take care of peat as would be necessary with coal and, that when it comes to shovelling by hand there are few commodities which are more difficult to handle. Neither of these difficulties is necessarily prohibitive, but they must not be overlooked.

Wastage In Handling.

A few remarks on Item 6 may be interesting. Wastage in handling air-dried peat fuel occurs when the peat is harvested from the drying field, when it is dumped into storage, when it is screened in loading railway cars, and in the process of handling by the retailer. There is also a certain amount of waste due to occasional small areas on the drying field where the peat does not properly dry out. When peat is harvested at 30 per cent water content there is no occasion for losing over 1 per cent of the fuel in this operation, and even dumping the 30 per cent blocks from a 25 foot trestle does not produce serious breaking up, the total smalls being under 10 per cent. This would represent a dead loss in a plant manufacturing air-dried peat fuel for domestic use only, but these screenings still retain their full value for other purposes and in order to make the manufacture of air-dried peat fuel for domestic use a success, it is, paradoxically, essential that peat be supplied for other purposes also. This statement of course does not hold true if the air dried peat is briquetted or burned as a powder.

If the peat is harvested at 25 per cent water content, or under, the wastage due to fines is much greater than that just mentioned and might easily become sufficiently serious to endanger the success of the plant under discussion.

The normal wastage in delivery from the cars to the domestic consumer by the ordinary channels through which coal passes is not over 5 per cent and usually much less, but when taken all together probably not more than an average of 90 per cent of the total peat laid out to dry can be sold as fuel for domestic use.

Items 7 and 8 are mentioned only to draw attention to the very evident fact that before a net profit is figured all overhead charges must be taken care of. Not a few peat promotions in the past have gone on the rocks because the cost figures in estimating final results expected have been production costs only with nothing set aside for amortization or depreciation and very little for executive and the other overhead charges which have to be met.

The sum of these charges may easily amount to over 20 per cent each year of the total capital investment in a peat proposition and must be charged against the peat made during the same period.

Production Cost.

It is to Item 9, however, that most attention will be paid in this discussion, as this item is perhaps more interesting to those present than are the others and distinct progress in the actual process of recovering peat by air-drying methods, on a large scale, has recently been made in connection with the investigations being carried on by the Canadian Government.

For domestic use the manufacture of air-dried or machine peat fuel consists in excavating the raw material, thoroughly grinding, mixing and kneading it, spreading it out on the adjacent surface of the bog carefully moulded in suitable pieces to dry, turning or disturbing these blocks to facilitate drying, picking them up when dry, and delivering them either into railway cars or storage. Primarily, the only way of getting production costs down to a minimum is by handling large quantities of material, as it is only in this way that machinery can be economically used to replace hand labor. The use of machinery means capital outlay and production on a large scale is necessary in order to bring the overhead down to a reasonable figure per ton. Besides, the season for air drying is short and three days' production for a plant working all the year around must be accomplished in one day in a peat plant.

The first machine necessary is the excavator, and in this connection it may be stated that the writer has no knowledge of any mechanical excavator used for other purposes which can be used

with as great economy to excavate peat as an excavator specially designed for the purpose. Standard excavators are usually too heavy to be supported on the surface of a bog, and while it is true an excavator of standard type might be supported on a floating scow in the excavation, it is doubtful if anything can be gained by this type of excavating over a land supported design. Raw peat is a light yielding material and while excavating shovels must be strong enough to resist encountering the roots found in some bogs, they do not need to be so rugged as the shovels necessary to excavate clay, sand, gravel, or other materials met with in construction work. This permits of lighter machines than could be used for other purposes, but even with this advantage a peat excavator must be supported over a comparatively large area on the bog surface. Labor necessary in arranging ties and track as used with the ordinary steam shovel, on the soft yielding surface of the bog, together with the troubles encountered due to the track sinking are almost prohibitive, and, it has been found that these problems are practically eliminated by the use of caterpillar carrying elements, similar to those now in use on tractors and the like, but designed to meet the unusual conditions met with on a bog. The problem of steering a comparatively heavy machine supported by necessarily large caterpillars offered many difficulties, but these have been completely solved.

It is not safe to allow more than two to three pounds per square inch on the surface of an ordinary bog even after it has been comparatively well drained. This statement refers of course to bogs similar to the one at Alfred, Ontario, which averages about nine feet deep and is well drained.

At Alfred, for the investigations of the Peat Committee, steam power sufficient to operate the excavator, macerator and the other machinery has been installed directly on the excavator framework, which makes the problem of supporting and moving very much greater than would be the case if a stationary power plant were used and the excavator and other equipment driven electrically. Generally speaking, for driving equipment which has to be moved over a peat bog, electric motors are to be preferred to any other power, even if a stationary generating plant has to be installed.

The excavator element itself differs from the ordinary bucket excavator in that the buckets are placed some distance apart and between them are a number of steel hoops, sharpened on the cutting edge, which serve the double purpose of cutting up the peat in the

process of excavation and keeping the larger roots out of the macerator. The excavator element used at Alfred has been found entirely satisfactory for the work it has to do. The Alfred bog varies from practically no roots at all at one part of the excavation to an accumulation of roots at another part almost great enough to hinder the manufacture of peat, and varies in depth from about four feet to about eleven feet, so that the conditions met in almost any average bog have been met at Alfred.

From the excavator the raw peat is delivered through a series of spiral conveyors to the macerator, which is a modified form of the well known Anrep Macerator Machine, originally developed in Sweden. This machine up to the limit of its capacity has given fair satisfaction, the major difficulties being due to occasional roots and sometimes pieces of metal which unavoidably find their way into the machine. While the macerator is not perfect it is quite commercial, but it is anticipated that some further changes will be made along the line of improving the macerating element before the investigations of the Peat Committee are complete.

The excavating and macerating of peat, however, is not so serious a problem as is the economical distribution of the macerated pulp on the drying field.

At Alfred it requires about ten cubic yards of macerated peat slop to make a ton of 30 per cent moisture fuel. In the process of excavation a certain amount of water is picked up, the water content of the drained bog being approximately 87½ per cent, while the water content of the peat slop is about 90 per cent, and it has been observed that the raw material is more easily macerated and dried into a better fuel the more water it contains. Owing to the cost of handling the material, however, it is probable that the 90 per cent water content is about the maximum which can be used in practice. Peat at Alfred is laid out in strips twelve feet wide and a little over four inches thick, and under these conditions it requires about 700 square feet of drying area to lay out the raw material necessary for a ton of fuel. This means nearly two acres to lay down 100 tons of fuel per day, and since it requires, during some seasons of the year, from 40 to 45 days to complete the drying, it is necessary to have a drying field of nearly 100 acres, or twice this much for day and night operation, to take care of the output of a one unit plant. Peat slop must be conveyed to every part of this large area and efforts to do this have been made along three lines.

In the early part of the Committee operations a complete Anrep spreading system using a rectangle of portable steel track, an Anrep cable haulage system to pull the hopper cars around this track and a spreading device based on the Jakobson's field press were used and discarded primarily because the capacity of this system is limited to the speed with which a car can be dumped into the spreader device and cleared away for another car, secondly, because of the large amount of manual labor necessary to operate the system and, thirdly, because of the large proportion of time wasted in moving the tracks from place to place. This layout was called Plant No. 1.

The second system tried out gave more promise of success. This is known as Plant No. 2 and is identical with Plant No. 1 in the excavator element, the macerator, the caterpillar carrying elements and the power equipment, but these elements are differently arranged. In Plant No. 1 the excavator element moves backwards and forwards on a support which is part of the excavator frame, cutting out a prism 28 feet wide, which necessitates an average move ahead per day when making six tons an hour of 65 feet. The No. 2 excavator element is kept up to its working face by moving the whole machine ahead, the excavator peeling off about six to eight inches from the working face. This necessitates the whole machine moving a distance of about 3,000 feet for the same daily production as the No. 1 makes in moving 65 feet. The peat slop, however, is distributed from this machine by the use of a belt conveyor and a spreading device which differs from the spreading device of Plant No. 1 in that the peat is moulded a uniform depth by being forced through an opening in the spreader rather than being dumped on the bog surface and smoothened down as is done in the Jakobson press. The peat from this spreader has the advantage of drying much more uniformly than that laid down by the No. 1 machine, although, were the surface of the bog perfectly level and free from humps and depressions the No. 1 spreader would work fairly well. This, however, is a condition which would hardly ever be realized in practice although there is no doubt that the drying surface improves materially after repeated spreading.

The No. 2 Plant spreads from the belt conveyor in a direction parallel to the working face and owing to this difference from the No. 1 Plant it is possible to use the same belt to simultaneously convey the peat slop to the drying field and the harvested peat to harvesting cars. When the plant is in regular operation the raw

peat is taken in at one end of the machine and the equivalent in dried fuel is delivered into storage or the harvesting cars at the other end. This machine has been in more or less continuous operation during the past season and so far as its mechanical operation is concerned has shown a very remarkable economy in the recovery of 30 per cent moisture fuel, but, it also has been discarded, for general use, for the following reasons.

Primarily, the very great length of working face necessary has three main faults which are common in a greater or less degree to the Weilandt and Strenge machines made in Germany and to one plant at least built in the United States. The principle of these is the fact that in order to intensively operate any property it would be necessary to cut it up with parallel excavations in order to get a sufficient length of working face for the several units necessary. This would mean that ultimately there would be a number of long islands of peat which would be too narrow for the machine to operate on and a large portion of the bog would be wasted, or would have to be recovered with some other type of machinery. Again, the very long working face necessitates correspondingly increased harvesting equipment which adds to the cost of harvesting and also to the overhead cost due to the increased capital outlay. Finally the first two or three cuts made in the spring over this very long face, owing to the effect of frost under our climatic conditions, produce inferior fuel only a part of which can be economically used even for operation of the plant. This last objection, however, does not apply where the peat excavated is to be briquetted or used in powdered form, or in a gas producer.

An additional objection is the complication due to combining the excavating and harvesting operations. While very effective, this combiation requires that all parts of the plant go along continuously, as a stoppage in any part of the operations means the holding up of the whole plant. Weather variations also tend to make this combined operation unsatisfacory. A continued dry spell may result in the peat on the field becoming too dry before it is harvested, while an abnormally wet spell means that the whole plant is held up until the spread peat is dry enough for harvesting. Practice has shown that it is better to make the laying down of the peat and the harvesting two separate operations.

Finally the amount of peat excavated has got to be exactly sufficient to fill the spreader, or uneven spreading will result. This requires a skillful operator who is an expensive man to carry, as.

after he is educated, he has to be kept over the period while the plant is idle in order to have him available for another season.

Despite these drawbacks, however, the No. 2 Plant accomplishes more spreading with two men attending this part of the operation than can be done with nine men on the No. 1 system and the delays due to moving tracks in the No. 1 system are eliminated.

With this knowledge available it was then decided to combine the good features of Plants No. 1 and 2, and a portable belt conveyor 850 feet between centers, together with a spreader device built on the principle of the No. 2 spreader to operate with this belt have been installed, and this combination is now in process of being tuned up.

The capacity of the new spreading outfit is limited only by the capacity of the excavating and macerating machine. The labor necessary to operate the system and the delays due to shifting have been cut down to a minimum and all mechanical problems appear to have been completely solved.

This combination plant is readily adjustable while in operation to variations in the depth of the bog and a number of units, if required for intensive development, could be installed on a comparatively small bog and practically all of the usable peat removed, the spreading finally taking place on the margin of the bog or if necessary on the adjacent land.

Investigations are also in progress as to the best depth and size of block to lay down. Peat slop dries very much more rapidly the thinner it is spread. If it is spread too thin, however, it will cover too much ground necessitating excessive moving of the plant, and if it is spread too thick, owing to the relatively slow drying, it requires too large a drying field. Investigation is being made to find out the happy medium. Peat was spread during the past season from four to four and a half inches thick, and can be spread in the early part of the season somewhat thicker than this. The length of the spreading season can also be prolonged by spreading somewhat thinner towards its close.

Surface conditions of the drying field have a very marked effect on the rapidity of drying. Perhaps the most interesting observation in this connection followed the disposal of some peat which was laid too late in the fall to become sufficiently dry to harvest. The following spring this peat dried out but on account of the frost was

soft and of no use for the domestic market and with the idea of levelling the spreading field it was spread over the surface and later other peat slop spread on top of it. It was then observed that the peat slop over the levelled area dried very much slower than on the adjacent field where no old peat was present, and, during the latter part of the season could scarcely be dried at all owing to the fact that the fine powder on the drying surface seemed to attract water from underneath and kept a wet surface in contact with the drying blocks all the time. In order to overcome this difficulty and also to improve certain parts of the field where fire had burned off the surface moss, different kinds of seed have been sown, the result of which will be observed next season.

After peat has been laid out for about ten days the block has become sufficiently solid to handle and drying is greatly facilitated by disturbing the blocks, turning the wet under-side to the air. This is not absolutely necessary, but has been found worth while. In practice at present the blocks are turned upside down by a man using a rake, who works on a contract basis, but it is hoped this can also be done mechanically as soon as some further experiments are made. Until year before last the blocks after being turned were stacked up into small piles called cubes, similar to what is done in European countries, but this has been abandoned owing to the fact that while the top blocks dried out more quickly and thoroughly the bottom blocks did not and very uneven drying resulted.

In from two to four weeks after the blocks are turned they have dried down to 25 per cent or 30 per cent moisture content and are then ready for harvesting, and it was only when a large quantity of peat had to be harvested in a comparatively short time that any attention was paid to the problem of harvesting, the idea being that ordinary standard equipment could be used in this operation to advantage. This operation was carried out at first by laying portable all steel track sections, similar to that used in the Anrep spreading system, between the rows of dried peat and filling harvester cars holding a ton and a half each with the dried peat by hand labor using coke forks. This, however, was found to be a costly operation, both in the labor necessary to fill the cars, and to push them out off the porable track to a main line where they could be hauled by a locomotive, and in the time necessary to move the tracks. Two new devices were therefore worked out to successful operation, one of them a self-propelled conveyer trough carried on

caterpillars, with one end elevated to load the peat into the harvesting cars, and the other, a small special type of tractor. This portable conveyer spans four rows as laid out by the spreader and, owing to added convenience, cuts down the number of men necessary in the operation about fifty per cent, besides making it possible to harvest a field by shifting the track once for every eight rows, instead of as formerly shifting every second row. The tractor, gasoline driven, is adapted to run on the light steel tracks which are literally dropped on the bog without any ballasting whatever and readily does the work of four to eight men handling the cars.

The main track is laid with twenty pound rails, and a three-ton Plymouth gasoline locomotive is used to haul the fuel to a loading trestle where the cars are hauled up and dumped directly into open coal cars, or into storage as desired. The system of handling from storage to railway cars, at Alfred, leaves much to to be desired. When it was first built it was not expected the operations would reach the extent they have and the less said about it in its present condition the better.

In connection with storage, however, it may be repeated that dumping the fuel blocks from the trestle, twenty-five feet above the ground does not produce a large amount of fines if the peat contains 30 per cent water, but at 25 per cent water and under, from ten per cent, up, of fines, are produced and where peat of this kind is loaded for shipment, it is run over a screen before reaching the cars, and the screenings returned to another storage.

Uses of Peat.

The title of this paper in the program mentions the "utilization of air dried machine peat fuel" but, to go into this phase of the propcsition would require another paper. The Peat Committee have confined themselves to selling fuel for domestic use, as it would be a very difficult thing to introduce it into industrial use until there is a sufficient reserve on hand to warrant an industry preparing for its use. It is anticipated when the Peat Committee have issued their report a number of commercial plants will come into existence and such a reserve will be built up, and only then can the industrial use of peat be promoted. The fuel can then be used either in its present shape as a low grade fuel for steam raising, for drying operations, more particularly where a very clean fuel is desired, for burning brick, for drying out moulds in a foun-

dry and for many other purposes which have not yet been tried out. Or it may be further dried, powdered and used for steam raising in this condition. It may be retorted and a very excellent peat charcoal or coke produced, or it may be fired directly to a by-product-recovery producer to generate electricity, incidentally recovering the nitrogen content and other by-products.

Besides these uses the screenings from the fuel may be pulverized and used as a conditioner for the soil, although there may be some question as to whether peat for fertilizer filler can be best recovered by the method herein described, where the raw material is macerated, or, by other methods which have been and are being developed by those in this business.

As a domestic fuel peat has been sold to a large number of consumers who have been and are being regularly supplied. It is used as a Fall and Spring fuel in furnaces, as a fuel for open fireplaces, for cooking purposes, as a kindling, and, generally, as an auxiliary fuel with anthracite during the severe winter months. It is the writer's opinion that a householder can get more useful heat and convenience if he buys peat equivalent to 20 per cent of his regular coal supply, ton for ton, than if he bought coal only.

It is obvious that figures in connection with the work of the Peat Committee cannot be published until the Committee have issued their report, which explains the absence of any in this paper. The only statement which can be made at present is that the work of the Peat Committee has been sufficiently promising to warrant the construction and operation of the large combination unit which is ready for demonstration during the coming season, and, in the meantime, any of the members of the American Peat Society who are sufficiently interested will be given a hearty welcome at the Alfred plant which will be open for the next thirty days, and from the middle of April on, in 1922. The plant is reached from Montreal after about two hours run on the C. P. R. main line from Montreal to Ottawa.

The writer sincerely regrets his inability to be present at the Fifteenth Annual Meeting of the American Peat Society and to take part in the very interesing discussions which will undoubtedly take place in connection with the valuable papers which are to be presented, and suggests that it would be of great value to everyone concerned if discussions of this or any other paper could take place on the pages of the Journal.

RECENT PROGRESS IN THE CULTIVATION OF PEAT SOILS.[1]

By Homer C. Thompson
Cornell University, Ithaca, N. Y.

The high-sounding title of this paper might lead one to believe that the writer has discovered some new and startling facts concerning the growing of crops on peat lands. This is not the case. I desire to bring to your attention a few things that have been found out, mainly by others, and to add a few words of warning.

During the past ten years more has been learned about the peat soils of the United States than had been learned in the previous fifty years. This Society has had a great deal to do with the learning. Partly as a result of its efforts, state agricultural colleges and experiment stations, the United States Department of Agriculture, the United States Geological Survey, and the Bureau of Mines have undertaken research and experimental work on peat soils. The soils themselves have been studied in the field, in the greenhouse, and in the laboratory, and a great deal has been learned about their origin, chemical composition, physical characteristics, and value for various purposes. Through observation and experimentation a great deal has been learned about crop adaptation to different kinds of peats and the fertilizer requirements for the various crops when grown on these soils. Results of most of the research and experimental work have been made available through publications of the experiment stations and through the journal of this society. I desire especially to call your attention to the publications of the experiment stations in Minnesota, Wisconsin, Michigan, Illinois, Indiana and Oregon. Recent bulletins from the Minnesota Station are of special value.

Crops For Peat Soils.

A good type of well-decomposed peat soil is considered the very best soil for celery, lettuce, onions, carrots and spinach. Cabbage, potatoes, beets, parsnips, sweet corn and other vegetables are grown satisfactorily on some peats. However, if the entire acreage of cabbage, celery, onions lettuce spinach, carrots and beets are grown

[1] Delivered at the Fourteenth Annual Convention of the American Peat Society, New York, September, 1921.

in the United States was produced on peat soils it would require less than three per cent of the area of Minnesota's peat deposits. This shows conclusively that if any considerable portion of the peat area of the United States is to be utilized in the near future for agricultural purposes, crops other than those mentioned must be grown. Corn, especially for silage, is grown to a considerable extent on peat soils in regions where summer frosts do not occur. Small grains, such as wheat, rye, oats and barley, have been grown quite satisfactorily in many sections. Hemp, mint and other special crops are grown to a limited extent in some regions. Probably the greatest opportunity for utilization of large areas of peat soils in the Northern States is in the production of hay and pasture grasses.

Since the writer is better acquainted with vegetables than with the other crops he will devote the remainder of the discussion to them.

Fertility Problems.

The fertilizer problem has been studied by several investigators and in most all of the experiments of which we have record, potash has been found to be deficient. Because of this fact it has been assumed by many that potash is the only element that needs to be supplied. In most all cases, however, phosphorus when applied with potash has been found to be of benefit on all crops on peat soils. Dr. F. J. Alway of the Minnesota Experiment Station has found a phosphorus-hungry peat soil, which during the first two years of cropping, has not been benefited by applications of potash. Phosphorus has greatly increased the yields of small grains, grasses, clovers, rutabagas and potatoes, while potash alone and in combination with phosphorus, has given little or no increase in yield. It should be noted, however, that the results are for two years only. After a few years of cropping potash will probably be needed. This illustrates the value of experimental work to find out the needs of the soil to produce various crops successfully. Experimental work of this nature needs to be carried on through a period of years, especially on new tracts. Experiments carried on for only two or three years may give results which would not apply after the land has been cropped for several years. Many tracts of peat soil have produced good crops for two or three years, without any fertilizer, but in subsequent years fertilizers have been found essential.

Most peat soils are rich in nitrogen and it has been assumed by many that this element need not be supplied in fertilizers. This is often the case in growing many crops, but for some of the intensive crops, such as celery and lettuce, nitrogenous fertilizers give good results. Many farmers, knowing this, assume that nitrogen should be applied to all crops. In New York State, for example, onion growers often use a fertilizer containing 2 to 4 per cent of nitrogen. Experiments conducted by the United States Department of Agriculture and by two or three experiment stations have shown that on some well decomposed peats, at least, nitrogen is not necessary. In fact, organic forms of nitrogen have been found to be actually detrimental in some instances because of the tendency to stimulate foliage growth late in the season when the bulbs should be ripening.

Stable manure has given excellent results on new land, due to a considerable extent to the organisms it carries. The manure carries bacteria and fungi which cause decomposition of the organic matter. It is advisable, therefore, to make a light application of manure to new peat soil regardless of the fertilizer to be applied. After the soil has become decomposed manure has little value except for the plant food elements it contains.

Disease Control.

Vegetables grown on peat soils are subject to all of the diseases and insect pests that are found on the same crops produced on mineral soils. In many regions, especially where the soil has been under cultivation for a long time, celery blight, onion smut and bottom rot of lettuce are quite serious. Tip burn of lettuce is also very serious during very hot weather. Celery and onion smut can be controlled in a practical manner as has been demonstrated by growers in New York and elsewhere. In Wayne County, New York, nearly all of the growers keep the celery blight under control by spraying with Bordeaux mixture. Onion smut is controlled by the formalin treatment, the material being applied in the furrow just behind the shoe of the seed drill. Increases in yield of 200 to 400 bushels of onions per acre have been secured from this treatment even where the yields were quite satisfactory without any treatment.

No satisfactory control measures have been found for bottom rot and tip burn of lettuce. There is evidence that potash increases

tip burn. It is doubtful, however, if the potash can be reduced sufficiently to materially lower the amount of tip burn without decreasing the yield and lowering the quality of the lettuce. This subject needs thorough investigation.

Need For More Research.

I dislike to close this paper without making a plea for more research on the problems of peat land agriculture. One of the great needs is for a soil survey similar to the surveys that have been made on mineral soils. With a thorough field survey combined with laboratory studies the peat soils might be classified in the same way that mineral soils have been classified. The classifications that have been made have been based largely on the type of plants from which the peat is derived. This is good but we need to go farther. Then there is need for fundamental research on the fertility problem. This should extend farther than field plant studies. It should include laboratory and greenhouse experiments. We need to know about the chemical and biological factors affecting crop production on peat soils. In short we have just begun to attack the fundamental problems and really know very little about peat land agriculture. The various States are beginning to realize the potential value of the peat deposits and money is being appropriated for studying the problems. This is the most hopeful aspect of the situation, for little need be expected until the value of the peat deposits is recognized.

PEAT AS A CARRIER FOR BACTERIA.[1]

By George H. Earp-Thomas
Director of Research, Earp-Thomas Cultures Corp.

Peat has been utilized for years as a fuel, fertilizer-filler, stock-food, litter, and as a bacterial food or carrier, mostly the latter. We are interested mainly in peat as regards its place in the growth and development of beneficial bacteria.

Of the many varieties of peat the black, thoroughly decomposed type is the most desirable kind to use, as such peat is more thoroughly oxidized, heavier, more compact, and contains less of the bacterial inhabitory acids such as geic, aprocrenic, and ulmic. The humic acids are less troublesome than the others, as they can be controlled for bacterial purposes by a thorough weathering by exposure to the sun and air, inoculation of beneficial varieties of soil bacteria, and by applications of lime, thus converting the humic acid into humates of lime, etc.

A great deal of study and experimental work has been done to utilize peat in its different forms for the growth of bacteria of various kinds, particularly fertilizing varieties, notably the legume varies, for the inoculation of seed; but the results have often proved disappointing, as so much depends upon the condition of the peat and the locality from which it has been selected.

I know of a particular case in New Jersey where legume bacteria grew vigorously and produced good clover with an abundance of nodules in a peat bed where the conditions for their growth proved good; while just across the hill, within a mile from this property, on a peat bed very similar in appearance but not so well drained, the same bacteria failed to grow; it acted like a germicide.

So the conditions of the peat bed and the topography of the country have the greatest influence in determining the suitability of peat for bacterization. With undertilling this land has since shown very satisfactory results. The drainage was a very vital factor in bringing out the plant-food values of this peat. Much of this was locked up in the form of complex chemical compounds which are poisonous to plants. They are produced by the growth of Protozoans (small animal forms which are the greatest natural enemies of bacteria and greedily live upon them). But fortunately they are

[1] Delivered before American Peat Society, September 9, 1921, New York City.

destroyed more or less by drainage; and then the beneficial soil bacteria live upon and break up the gummy complex chemical bodies, converting them into soluble plant foods, which largely accounts for the wonderful results, which are usually produced the third season, from peat beds which are cleared and drained.

It is of course possible with money to make almost any bed of peat a favorable medium for such bacteria. But from my experience, after fifteen years of careful study, I feel that the least amount of money spent on preliminary treatment the better at this time, as peat is dear enough to move even under the most satisfactory conditions. As one of my associates said after the first three months' experience of bringing in peat to the plant: "It looks as if it could be moved in for 30 cents a ton, but when it is in it costs about $30." But there is a way to move peat economically from almost any given locality, but there is a problem for the engineer, and interests us only in so far as it relates to its removal as food for bacteria.

I have always said and still believe that the only way to determine the suitability of peat as a bacterial food and carrier is to put the bacteria in the well-prepared, natural bed and find out how long they survive and how many you can take out. This may sound like a big job to the uninitated but it is very simple to the bacteriologist. If they grow and propogate the material can be called first-class. If they all die, it is necessary for further, careful work to find out the remedy and the cost of correcting the condition. Usually more drainage and lime is necessary, and sterilization of the peat essential. This work is slow and expensive, and it is often better to select a bed of humus in a locality which lends itself to more favorable development.

In selecting a bed it is advisable to examine the surrounding conditions very carefully, Rising, high, dry land with luxuriant vegetation, strong bark and evenly arranged branches on trees, with well-developed leaves and a plentiful supply of blossoms, and where grass and clovers grow abundantly, are an indication of an ideal condition. The peat area should lend itself to easy and complete drainage. The springs should be tapped at their source by main drains and undertilling for lateral or open drains placed suitably apart throughout the cultivated area. The drains should be so arranged that irrigation can be supplied at will. With this condition brought about it is advisable, after the drainage has been in opera-

tion long enough to bring about the right texture of the peat bed, to test it in various localities for its reaction, and correct the acidity to a slighly alkaline point by the application of lime and wood ashes.

It should be cultivated carefully and inoculated with nitrogen bacteria and planted to various legumes to determine its conditions. In from fourteen days to six weeks nodules should be visible on the roots of any legumes, and it may then be assumed that the peat is in favorable condition for bacterial action as a fertilizer filler and plant and soil developer. The resultant crops of any kind will have a greater nutrient value for feeding purposes, because the flora is of a favorable kind to produce clean, healthy by-products to be digested by the plants.

Plants have to some extent a selective ability in regard to soil solutions upon which they subsist, but only to a limited degree. As an example: Asparagus can live in a salt bed and still utilize potash for its growth and development and exclude the soda, taking only sufficient for its requirments; whereas, lettuce would be surfeited with soda and obtain no potash, and the cells would shrink and perish, due to excess of soda. The same condition applies to many other crops and their food materials, and often leads to crop failures. After cultivation has proceeded for a short time it is often noted that an excess of salts or other toxic elements in the soil are washed out by recurrent rains and if certain crops fail in the first and even the second year of trial, it need not be concluded that they will not do well in subsequent seasons. By heavily inoculating such soils a much more rapid recovery will take place, especially when legumes are planted. But the inoculation must be repeated each season, as many bacteria are lost in the struggle for supremacy.

It is true that a toxic soil produces toxic food crops which are more or less unpalatable and certainly not conductive to good health —all of which has a distinct bearing on the preparation of fertilizing materials for producing food plants in a healthy and nourishing condition.

The invaluable vitamines of all kinds originate in the soil through bacterial action and are absorbed into the plant and become a valuable and essential part of the tissue-building qualities of such plants. Many bacteria of the soil are vitamine producers and undoubtedly get these strange chemical bodies from the soil they inhabit, but the reactions must be right in the soil for such microorganisms to grow or the food will lack the vitamines, and possibly

the soil likewise. The crop cannot exclude all toxins any more than the lettuce can exclude an excess of soda. Such toxins find their way eventually into the ailmentary canal of man and beast, and use up energy to be eliminated or neutralized, or produce a favorable nidus for disease bacteria to enter and attack the individual absorbing such refuse. Finally such matter enters the blood and produces kidney lesions and other disturbances which are directly responsible for shortening the natural span of life.

So it can be seen that good health arises from the soil, as well as all our wealth. Any very remarkable improvement in our health condition must arise from its fundamental source—the soil. By improving the soil conditions so that we can have a well-balanced ration of good material, both animal and vegetable, metabolism will take care of our health as nature intended it should

We are chemists enough to determine by one of our special senses, the organ of taste, the quality of the food we eat. The food of any kind from a healthy soil is of luscious flavor, showing that it is of good chemical composition, holding the elements necessary for body-building, and free from toxic matter of an injurious kind. This proves clearly the necessity for careful soil preparation, so that crops may be produced under the right condition to promote health and maintain mankind in a physically fit condition.

What the gastric juice is to the stomach in the digestion of food, the bacteria of the soil are to the plant. The soil must be digested by weathering and by bacterial action for the crop to survive. I believe future progress in soil development will come from the soil bacteriologist rather from the soil chemist.

For the last two decades many attempts have been made to utilize peat as a bacteria carrier, with more or less success, but nothing yet has been accomplished which can be called at all startling. Most of the work has been limited to the production of inoculated humus for legume culture, but I believe that within the next five years there will be produced inoculated humus compounds that will show far superior results in crop production of a clean, healthy kind than has hitherto been possible with manure or chemical fertilizers. The trouble is that too few biochemists have been working on the problem, and too much pessimism exists among the laity and the professional world as to the necessity and efficiency of bacteria for such purposes. But enough already has been accomplished in the crudest factories, with but superficial guidance, to show that inoculated humus compounds can produce vegetation second to none.

In Virginia in 1918 nine first prizes were awarded to farmers who exhibited produce raised by inoculated humus compounds, and many reports showed that a large percentage of the users of the material had had results that were superior to anything hitherto tried. But again, the product was not standardized. The humus was not always of the same good quality, which soon became apparent by laboratory examination. Where the count of beneficil bacteria was 30 billions to the gram of material, excellent results were obtained when used at the rate of 500 lbs. to the acre; but in some lots of humus the count was but a few thousand, and the material had to be condemned. Hosts of the natural enemies of bacteria in the form of protozoans had mastered the field. These small animals greedily devour bacteria and leave in the soil highly complex chemicals which are neither food for plants nor animals, but are readily broken down by the action of good soil bacteria into soluble plant foods. The frozen protozaans must be controlled both in the fertilizing material and in the soil. I believe that many diseases of plants are directly traceable to their baneful influence. They can be eliminated by proper preparation of humus, by sterilization, dryness, and by application of chemicals or lime; but it is best to free the humus bed of the pests—start right and prevent a world of trouble afterward through depredations.

The most valuable bacteria for humus-fertilizing compound include the nitrogen-gathering bacteria, both the pseudomonas Radicicola for legumes and the azotobacter nitrogen-gathering bacteria for general crops, the acid bacteria, nitrifyers, and the sulphur bacteria—all bacteria found in very favorable soils, which under carefully checked-up tests show themselves to be of special benefit in decomposing either the organic or the mineral matter of the soil. Some soils are unfavorable to their development through lack of drainage, poor cultivation or the wrong reaction. The condition should be corrected before the most favorable results can be expected. It is more profitable to have a few acres in prime condition than a large acreage unproductive or unfavorable.

A humus fertilizing compound should be alive with crop-producing bacteria of at least 30 billions to the gram. The reaction should be 1 per cent alkaline; the material should contain phosphates to meet soil requirements, and potash for all root and other crops requiring this element in large quantity. Enough lime should be supplied to the soil at least to bring it to a neutral reaction. The

condition then will be favorable for the humus fertilizing compound, and to show that soil development for a profitable, healthy crop is largely a matter of the proper bacterizaion of the soil, through the use of peat properly prepared, the most valuable of all bacteria carriers.

IMPROVEMENT OF PEATY SOILS.

By E. J. Russell, D. Sc., F. R. S.
Director Rothamstead Experimental Station.

Part II.—The Silty and Sandy Peats.

These soils form a transition between the true peats and true soils; they arise in conditions where bacterial action goes on more slowly than in ordinary soils, but more quickly than in true peats; organic matter, therefore, accumulates but without forming a separate vegetable layer. They may also arise when a true peat, after drainage, shrinks and finally disppears, again exposing the old surface on which it had rested.

In general these soils present greater possibilities of reclamation than the peats. They usually have the same defects as the peats, viz., wetness, acidity and lack of phosphates, but in a less intense form; it was through these defects that the soil bacteria were unable to complete their work, and until they are remedied crops cannot make proper growth.

Silty Peats.—An interesting example of the silty peats is found in Bodmin moor, Cornwall. The elevation is 800 to 1,000 feet and the rainfall probably about 40 to 50 inches; both are high enough to interfere with ordinary agricultural processes and with the decomposition of plant residues in the soil, but the conditions are more favorable than on the higher lying Dartmoor, and in consequence there is considerably less deposit of layers of peat. The composition of much of the moor soil is different from normal agricultural soil in its higher content of organic matter, but it is by no means as far removed from normal soil as is peat.

It is possible also that peat may have occurred on some of these areas, but if so it has been denuded subsequently faster than it could be reformed. Some of these soils have the composition shown in the table following.

	Wilsey Down		Laneast Down	Davidstow Moor	Cardinham Down	Wilsey Down	Laneast Down	Davidstow Moor
	Cultivated	Wild	Wild	Wild	Wild	Wild	Wild	Wild
Fine gravel	3.2	2.5	3.9	1.6	10.4	2.1	6.1	2.7
Coarse sand	9.5	6.3	1.8	1.5	17.8	6.3	3.9	1.7
Fine sand	26.3	31.5	20.2	15.4	16.4	32.4	19.2	14.1
Silt	18.1	20.5	21.3	33.9	13.6	17.0	18.2	34.1
Fine silt	25.8	19.1	25.2	17.0	11.0	24.0	28.4	18.8
Clay	2.4	1.8	4.5	3.1	3.5	6.0	9.1	11.2
Stones		12.5	12.4					
Organic matter	9.1	11.9	15.1	19.5	17.0	6.2	8.6	12.1
Nitrogen	0.31	0.35	0.46	0.63	0.48	0.15	0.23	0.29
Carbonates	nil	nil	nil	trace	nil	nil	trace	trace
Acidity		present	present					
Lime requirem't		0.48	0.67					
Total potash (K_2O)		0.21	0.53					
Phosphoric acid (P_2O_5)		0.04	0.10					

In all cases except Laneast the surface soil was black, underlain by a band of broken stone; lower down was a reddish yellow subsoil. Where drainage is possible there is no insuperable difficulty about reclamation; some has been carried out already on Wilsey Down. The first ploughing is heavy because of the broken stones, sometimes the work proves even dangerous when done with a horse plough; there is less difficulty with a tractor. More important perhaps than anything else in these high districts is the selection of suitable varieties of crops. The Cornish oat—"American"—is still grown on the old moorland farms as it has been for 40 years past. Preliminary trials indicate, however, that some of the newer sorts such as "Yielder" and "Golden Rain" may prove distinctly better. Phosphates (superphosphate or perhaps basic slag) should be liberally used to hasten ripening of the cereals and to improve the feeding value of the rape and seeds grown for sheep feeding. Nitrogenous fertilizers and lime are also likely to be effective. There is much room for carefully considered experiments on the improvement of these soils.

Another group lies at lower altitudes and under a smaller rain-

fall; it offers even better prospects of reclamation; examples are found in the Staddon grits of the Lower Devonian series at Newlyn Downs and St. Brioch's, Cornwall. Analysis of the soils gave the results shown in the next table (there are no important differences

	Newlyn Downs.		St. Brioch's.		St. Brioch's Subsoils.	
	Waste.	Cultivated.	Waste	Cultivated	Waste	Cultivated.
Laboratory number			10	11	10	11
Fine gravel	8.7	7.4	2.4	4.7	3.9	3.5
Coarse sand	9.2	5.5	6.1	8.5	7.4	7.2
Fine sand	20.3	18.3	28.9	22.8	29.4	21.3
Silt	24.2	27.8	17.8	30.3	16.2	33.9
Fine silt	17.5	15.3	20.8	12.9	21.0	11.0
Clay	6.6	10.0	9.3	6.6	9.2	11.5
Stones			20	15	17	24
Organic matter	7.6	9.2	9.6	9.0	6.1	6.9
Nitrogen	0.21	0.27	0.23	0.30	0.10	0.15
Carbonates	nil	nil	nil	0.02	nil	nil
Acidity	present	present	present	present	present	pres't
Lime requirement			0.06	0.23	0.37	0.21
Total potash (K_2O)			0.35	0.55	0.48	0.32
Total phosphates (P_2O_5)			0.03	0.07	0.01	

between the waste and the cultivated soils). An example of reclamation of this type of land is seen on Tremollet Down where a tract of 280 acres was taken into cultivation by the Duchy of Cornwall in 1909-10 at a cost of approximately £11 per acre. Since the land readily lets at £1 per acre the project has been profitable. The gorse and heather were burnt, and the land was ploughed; no further treatment was needed. The chief expense was incurred in making the road through the land and in setting out and enclosing the fields. These are of 8 acres each and fenced in with the usual Cornish earth wall faced with stone, on the top of which hazel and other bushes will grow; substantial fences are needed to shelter the live-stock. The main feature of the farming is stock-raising, and the farmers usually adopt the following rotation—oats, roots,

barley, seeds mixture—which is then left as long as possible; some of it has been down too long and is beginning to be weedy. The land obviously needs lime which was not applied as part of the reclamation; spurry, sorrel and polygonium are all common on the stubbles, but the reclamation has been a complete success.

Sandy Peats.—Numerous instances of these soils occur in Cornwall, and they are commonly in bad repute. Few people who know them speak well of the black granite, or as they are locally called "growan," soils of Cornwall, yet there seems no reason why they should not be cultivated. Some of them are very acid—one indeed is the most acid soil the writer has found in England—but this could be overcome by a sufficient dressing of lime.

The following analysis of soils are taken from the St. Buryan's district, between Penzance and Land's End; for purposes of comparison the values for a highly fertile potato soil near Penzance are also given:—

	Trevidder Moor.	Near Boscawen.		Ludgvan, Penzance.	
	Waste.	Waste	Cultivated	Highly fertile potato soil	
				Surface.	Subsoil
Fine gravel	21.0	9.3	8.0	2.8	4.6
Coarse sand	40.9	18.1	16.4	9.7	11.6
Fine sand	6.6	20.5	30.8	57.6	46.9
Silt	8.1	21.1	17.2	2.9	9.4
Fine silt	4.7	8.8	9.2	7.4	9.2
Clay	1.1	2.2	1.5	1.4	1.3
Stones	32	15	10	23	

The soils were all deep, and the subsoils, both at Boscawen and Trevidder, closely resemble the surface soils; the figures are omitted for the sake of brevity. Other waste areas in the district were similar in character to the Boscawen area; the analytical details need not, therefore, be given.

All that these waste soils need is clearing to remove gorse and bracken, then deep ploughing, finally a good dressing of lime and phosphates. The smallness of the difference between Boscawen waste and cultivated land shows that there is nothing in the soil to prevent cultivation. There are, of course, marked differences

	Trevidder Moor.	Near Boscawen.		Penzance Ludgvan,	
	Waste	Waste	Cultivated	Highly fertile potato soil	
				Surface.	Subsoil
Organic matter (loss on ignition)	11.8	13.2	10.0	8.8	9.4
Nitrogen	0.34	0.39	0.37	0.19	0.19
Carbonate (as calcium carbonate)	nil	nil	nil	3.2	2.6
Acidity	present	high	present	absent	absent
Ph value*	4.8	4.6	5.2		
Lime requirement for neutralisation†	0.40	0.73	0.44	none	none
Phosphoric Arid (P_2O_5) Total	0.10		0.08	0.25	
Potash (K_2O) Total	0.52	0.28	0.54	0.44	

*This measures the intensity of the acidity but not the quantity; 7.2 is the neutral point and the lower the Ph figure the greater the intensity

†This measures the quantity of acidity and also the amount of lime absorbed in other ways. The Hutchinson-McLennan method is used.

from the fertile potato soils of Penzance, both in the soil and even more in the position, but these could be used for several types of farming and for either small or large holders.

NOTE.—References to the literature on this subject may be obtained on application to the Ministry.

NEWS OF THE INDUSTRY.

Illinois.

The Illinois Peat Products Co., of Gilberts, Ill., was recently incorporated in the sum of $35,000 for the purpose of manufacturing and selling peat fuel, by-products, etc. The incorporators are John Ramus, Herman L. Stumpf, Henry G. Miller and Peter H. Miller.

Indiana.

Geologists and engineers of the Smokeless Fuel Co. state that there are 100,000,000 tons of peat fuel available in the deposits of Pulaski and Stark counties, Indiana. The company is said to be manufacturing peat bricks and getting ready for the spring trade. The fields from which the peat is obtained are about 70 miles from Chicago. It is stated that the fuel will be offered to residents of Chicago this spring.

The Chesapeake & Ohio Railroad is said to have tested the peat in an engine at Peru recently and has ordered two carloads to make a more extensive test. H. P. Hathaway, assistant general freight agent of the railroad, expressed surprise at the rapidity with which the engine got up steam with peat fuel. In a three-hour test, a general superintendent of the road reports, there was no smoke.

Maine.

That a manufacturing company is ready to arrange with the Peat Engineering Co. of Bangor, Me., for the construction and operation of a plant in Penobscot county on being granted rights for this county, was the announcement made Wednesday afternoon following a meeting of the stockholders in the Chamber of Commerce.

The contract which the firm is ready to sign provides for the completion of the plant by Jan. 1, 1923, and for the expenditure of at least $25,000 by July 1, next. If the company fails to comply with these conditions, it will lose its rights and contracts, thus insuring the early erection and completion of a peat plant in or near Bangor.

It was voted to ratify the action of the board of directors in the preliminary work undertaken by the company under their direction and it was also voted to ratify a contract made with Fred

T. Dow, inventor of the machinery which has made it possible to manufacture wet peat into dry fuel.

Fred T. Dow, William R. Dow, James M. Gillin, Esq., Harry J. Chapman, Esq., and Victor Hodgins, were elected directors for the coming year and Mr. Gillin was elected clerk.

Massachusetts.

The United States Peat Products Co., of Worcester, Mass., was recently incorporated with a capital of $99,000, divided into 9900 shares of the par value of $10 each. The officers are Charles Higginbotham, president, Edmund R. Cummins, treasurer, and Harry J. Fish, clerk. The company plans to produce and market peat fuel and dye.

New York.

The attempt of Louis Enright, 74 years old, of Farmingdale, L. I., to prove that he could manufacture naphtha from peat in a machine of his invention, failed in the Nassau County Court at Mineola recently. A deeply interested crowd watched him. He worked from 2 to 5 o'clock putting his machine together. Then he put several handfuls of peat in the machine, added a few pails of water, and ignited the peat with a blow torch. Court attendants worked a suction pump and compression pump at his direction until they were weary, but no naphtha was obtained. Enright finally told them to stop, saying there were leaks in the compression pump caused by the disassembling of the machine the previous day. He promised to give a successful demonstration later, but Judge Lewis J. Smith announced he would not permit any more tests to be made in court.

Enright attempted the demonstration to disprove the charges of William H. Doolittle, a druggist, of Cedarhurst, L. I., who is suing Enright for $1,000, which he says he invested in the Enricht Peat Gasoline Corporation on representations that Enricht could make gasoline from peat and that the company would pay dividends. The druggist charges the representations were false. On cross-examination by Doolittle's cousel, Enricht admitted yesterday that he was fined $500 in the Federal Court in Chicago in 1902 on the charge of using the mails to defraud.

He also admitted that he applied for a patent for his machine in October, 1920, but that the United States Patent Office denied his application on the ground that his scheme was contrary to the

known laws of physical chemistry. He said he had been making naphtha from peat since 1920.

A judgment in the sum of $1,000 was awarded against Enricht in the civil suit and he was later indicted for grand larceny.

Italy.

The following translation of an article, which appeared in the Popolo Romano of December 2, 1921, regarding work which is being done at the peat deposits of Campotosto, Abruzzo, Italy, has been forwarded by Commercial Attache H. C. MacLean:

Prior to the war the exploitation of the enormous peat deposits in Abruzzo was never taken into consideration, owing to the low price of coal. However, on account of high freights, exchange, and increased cost of labor, this work has now been commneced at Campotosto. The deposits are situated in the mountainous district of Laga, 1,300 meters above sea level, to the left of the Aquila-Teramo State road which leads to San Vittorino, Arischia, and Montorio al Vomano. These beds, which extend as far as the swamps of Mascioni and Poggio Cancelli, cover an area of 7,750,000 square meters, and vary from 6 to 14 meters in thickness, the total volume being estimated at 50,000,000 cubic meters. The Societá Industriale dell'Iterno, which has commenced the exploitation of the deposit, in less than two years has constructed a huge plant. In addition to the machinery for excavation and working of the peat, building of shelters for 1,000 workmen, store magazines. restaurants. and cooperative ovens have been erected, as well as the laying of railway lines and transport of equipment for transportation of the peat from the points of excavation and drying to the points where it is worked. Aerial railways for the transportation of the material from where it has been prepared to the Railway Capitignano-Aquila are also in operation.

The peat is excavated and pulverized by 45-horsepower Strenge engines. After a certain depth has been reached the engines automatically move on to new points. The peat is worked by groups of Buhler machines actuated by powerful 250-horsepower Tosi boilers. Afer the peat has been thoroughly dried it is shaped into small briquets, and by means of the aerial railway loaded onto the trains at Capitignano, whence it is shipped to various points in Italy. The aerial railway is capable of handling 800 cubic meters every 10 hours. A gallery 1,100 meters long passing under the Lame Hills carries off the water.

During 1921, the first year of the working of the plant, 60,000 cubic meters of peat were excavated producing 10,000 tons of briquets, although an annual production of 50,000 tons is provided for. It is estimated that 100 kilos of commercial peat is equivalent to the same amount of dry wood, or 40 kilos of Cardiff coal.—Commerce Reports January 23, 1922. P. 193.

ABSTRACTS OF PATENTS.

Treating Peat

By W. W. Blair.

Peat blocks are formed by compressing freshly dug or macerated, peat, and the blocks are then dried and finally impregated with a fuel oil, e.g. a heavy low grade oil. Peat is deposited from an excavating shovel upon a screen which removes surplus water, roots, etc., and then falls upon a drum having a number of aligned depressions into which the peat is pressed to form rounded blocks. The mass in each mould is subjected to increasing pressure from the casing before being discharged into a sliding chute which feeds the blocks into wire mesh receptacles for disposal in a drying rack. Alternatively, the peat after passing over a screen falls through macerating devices and is forced by plungers through vertical cutting plates to form continuous bands which are severed by a vertically reciprocating knife. Apertures are formed within the blocks by cores supported by thin blades which pierce the peat mass at the same time as the cutting plates. The blocks are delivered by an endless conveyor into a hooded chamber heated for example by steam pipes and are then stored or transported to the oil impregnating mechanism. This consists conveniently of an oil trough, mounted on adjustable standards and heated by a steam pipe, and a conveyer which is actuated by a drum and is preferably of reticulated material with side wires to retain the blocks in position.—British Patent, 172,359.

Briquetting Method

By H. A. Mueller.

Claim.—1. The method of briquetting saw-dust, coal-dust, air-dried peat and similar pulverous substances which comprises applying a condensible vapour to the pulverous mass until the air contained therein is essentially expelled, and then applying pressure until the vapour is condensed and the particles of the mass are brought into intimate contact with each other.

2. The method of briquetting saw-dust, coal-dust, air-dried peat and similar pulverous substances, which comprises supplying superheated steam to the pulverous mass until the air contained therein is essentially expelled, and then applying pressure until the

steam is condensed and the particles of the mass are brought into intimate contact with each other.

3. The method of briquetting saw-dust, coal-dust, air-dried peat and similar pulverous substances, which comprises preheating the mass to be briquetted, introducing a vapour in the heated pulverous until the air contained therein is essentially expelled, and immediately applying pressure until the vapour is condensed and a solid block free from included gas is formed.—Canadian Patent, 214,251.

Method of Manufacturing Fuel from Peat

By Le Combustible Nationale Limitré.

Claim.—2. The herein described method of producing a peat fuel which comprises sprinkling the peat with a solution containing caustic soda, lime, magnesium sulphate and calcium sulphate, and then allowing the same to dry.

5. The herein described method of manufacturing a peat fuel which comprises forming peat into briquets, then sprinkling with a solution containing caustic soda and slacked lime, then subdividing and drying.

7. The herein described method of manufacturing a peat fuel which comprises forming peat into briquets, then sprinkling with a solution containing caustic soda, slacked lime, magnesium sulphate and calcium sulphate.—Canadian Patent, 214,362.

Method of Treating Peat to Extract the Water from the Peat in the Bogs.

By William W. Camp.

My invention relates to an improved method of treating peat bogs to extract the water from the peat in the bog and primarily compress the peat, and the object of the invention is to separate the water from the peat and thereby enable the water to evaporate or to be drained off and the peat removed with a minimum amount of moisture, so that it may be compressed where desired by a suitable machine into blocks for fuel or other purposes.

A further object is to effect this treatment of the bog with a minimum amount of power at a minimum expense and thereby enable peat bogs to be utilized in a commercial way, which has

heretofore not been found practical on account of the exorbitant cost of treatment, which has rendered peat as a fuel an impossible competitor with other fuels, such as coal.

To effect these objects I follow the following method:

I first excavate the bog by any suitable excavating machine and for any predetermined width and depth according to the capacity of the machine throwing the excavated peat upwardly into a suitable macerator from which it is precipitated back again into the bog behind the machine.

It is then preferably packed by a suitable packing machine, so that it practically occupies the same or less space than what it formerly occupied in is natural state in the bog.

After the packing has been accomplished and the surface rendered firm again I preferably treat it with a suitable perforating machine consisting of a series of rods held in plates. These rods are preferably placed about two inches apart and the plates to which they are secured are given an oscillating movement under pressure, whereby the rods practically trowel the interior contour of the hole and thereby permit of the ready withdrawal of the rods.

This action of the rods and the machine whereby the plates carrying the rods are made to travel and are given the desired movement and pressure form no feature in the present invention but will be made the subject matter of a seperate application.

It is essential, however, that this perforation of the surface of the bog be performed and I find in practice that the desired depth to make the holes is approximately twelve to fifteen inches.

While I preferably perforate the newly formed surface of the bog immediately after being excavated and packed as hereinbefore described it will, of course, be understood that this operation may be performed at any convenient time such as in the spring of the year, it being, of course, necessary that it be done when the bog is wet.

The result of this perforation is to compress the peat and squeeze the water therefrom, so that the water will occupy the holes made by the rods aforesaid. As a consequence the evaporation of the water is facilitated to the greatest extent and I find in practice that evaporation will actually take place so rapidly that the holes are practically free from water on a good dry day within three or four hours practically as quickly as evaporation would take place if the holes were made in clay.

After the water has been evaporated as aforesaid I then preferably plow the surface of the bog so treated leaving the furrows longitudinally in their natural state after being plowed so that the air and sun will further remove the moisture. The perforations in the furrows allow of the circulation of the air, and, therefore, materially assist drying the separated peat. These separated furrows can now be loaded into wagons and either used as fuel or may be transferred to any suitable compressing plant, where they may be manufactured into blocks, thereby greatly reducing the bulk and making the peat suitable for transshipment.

When the peat is first plowed up it will dry down to about thirty per cent, moisture and it will, therefore, be understood that it may be utilized for a fuel in this condition or for other purposes, such as a fertilizer.

I should mention that the peat in its original condition before being excavated and packed as hereinbefore described is lighter than water. In fact in a peat bog under ordinary conditions it is floating in the water in the bog, but after being excavated, macerated and packed it then becomes heavier than water and practically impervious to water and thereby sinks to the bottom of the bog where if the surface of the ground is uneven it will follow the contour of the surface and thereby force all the excess water at the bottom of the bog out and take its place.

Such a method as I describe is revolutionary in the peat industry as all artifical drying is dispensed with and the great expense incident thereto. A bog of one hundred acres and eight feet in depth, which would ordinarily take thirty years to obtain all the peat therefrom can now be utilized in less than six years and at a greatly reduced overhead cost, that is to say at approximately thirty cents a ton by my method as compared with three dollars a ton by the best of the methods at present in use.

This greatly reduced cost is partly accounted for by reason of the fact that the bog may be prepared in any weather rain or shine, which it is not possible to do according to methods now employed.

What I claim as my invention is—

1. The method of treating peat bogs to extract the water from the peat therein consisting in excavating the bog uninter-

rupted step by step the desired depth to form a cavity, then macerating the excavated peat and then feeding such peat again into such cavity, which is continually formed by the ejection of the previously excavated peat.

2. The method of treating peat bogs to extract the water from the peat therein consisting in excavating the bog step by step the desired depth, then macerating the excavated peat and then feeding such peat down into the cavity, which is continually formed by the ejection of the previously excavated peat, then packing the macerated peat in such cavity.

3. The method of treating peat bogs to extract the water from the peat therein consisting in excavating the bog step by step the desired depth, then macerating the excavated peat and then feeding such peat down into the cavity, which is continually formed by the ejection of the previously excavated peat, then packing the macerated peat in such cavity, then perforating the newly formed surface of the bog.

4. The method of treating peat bogs to extract water from the peat therein consisting in excavating the bog step by step the desired repth, then macerating the excavated peat and then feeding such peat down into the cavity, which is continually formed by the ejection of the previously excavated peat, then packing the macerated peat in such cavity, then perforating the newly formed surface of the bog and separating the perforated strata from the mass beneath.

5. The method of treating peat bogs to extract the water from the peat therein consisting in excavating the bog step by step the desired depth, then macerating the excavated peat and then feeding such peat down into the cavity, which is continually formed by the ejection of the previously excavated peat, then packing the macerated peat in such cavity, then perforating the newly formed surface of the bog, and then separating the perforated strata from the mass beneath and exposing the separated perforated portions of peat to the air.

AMERICAN PEAT SOCIETY.

SCOPE AND PURPOSE.

The American Peat Society was organized at the national exposition at Jamestown, Va., on October 23, 1907, and was incorporated in 1912. Its purpose is to disseminate information concerning the origin, metamorphosis, geographic distribution, physical and chemical properties, and uses of peat, muck, and humus, and to stimulate interest in the commercial utilization of the widely-distributed, valuable deposits of these substances in North America.

NATURE AND USES OF PEAT.

Peat is the organic residuum resulting from the arrested decomposition of leaves, twigs, roots, trunks of trees, shrubs, mosses, and other vegetation in areas continually covered or saturated with water. It may be identified as the dark-colored soil found in bogs and swamps, commonly called muck. The commercial uses of peat are numerous and varied. In the countries of northern Europe it is used for fuel and as the basis for many manufacturing industries. Gas, substitutes for petroleum products, charcoal, coke, and a number of valuable by-products are produced in small quantities from it. Peat moss, marsh grass, and fibrous peat are employed in the manufacture of surgical dressings, of rugs and carpets, of packing material, of artificial wood, of paper, and of substitutes for cotton and woolen cloth. In the United States peat is utilized chiefly as an ingredient of fertilizers and stock food and as a crop soil.

ECONOMIC ASPECTS OF PEAT.

The United States contains about 12,000 square miles of undrained land estimated to be capable of yielding nearly 14 billion short tons of air-dried peat. The average deposit will yield 200 tons per acre foot. The peat areas are distributed throughout the Great Lake, New England, and Atlantic and Pacific Coast States. The peat deposits of Canada cover 37,000 square miles. The annual value of the products made from peat in the United States amounts to about $1,000,000. The proceeds received from the cultivation of peat and muck land are far in excess of this figure. European countries annually consume more than 50 million tons.

MEMBERSHIP.

The present membership of the American Peat Society consists largely of agriculturists and peat producers. Persons interested in agriculture, in soil fertilization, in the chemical and bacteriological aspects of vegetal mat-

ter, and in the production of fuel or generation of power are urged to join. Enrollment will be found as valuable by them as it is to the owners and operators of peat and muck areas, who consider their connection with the society a decided business asset. Applications should be addressed to the secretary. Membership and subscription to the journal cost $5.00 a year.

CONVENTIONS AND PUBLICATIONS.

The meetings of the society are held annually in important cities throughout the peat regions. Many original papers relating to the subjects enumerated are presented every year. A quarterly journal containing the proceedings of the society, news of the industry and contemporary literature concerning all phases of the peat and allied industries is published and sent to members. This journal is unique among the scientific publications of the United States, as it is the only one that treats all branches of the peat industry. Its success in stimulating interest in the possibilities of peat, in pointing out the location of deposits, in explaining production methods, in exposing the incompetent engineering practice that has caused many failures, and in stamping out false promotion, has been the subject of favorable comment throughout the world.

General inquiries relating to the objects of the society will be answered free of charge by the secretary or editor, but it should be understood that detailed information will not be so given. Such advice can be obtained from experts whose names will be furnished upon application.

APPLICATION FOR MEMBERSHIP
IN THE
American Peat Society.

---------- (Date)

MR. CHARLES KNAP, *Secretary-Treasurer,*
American Peat Society,
2 Rector St.,
New York, N. Y.

Dear Mr. Knap:

Application is hereby made for membership in the American Peat Society. Check in the sum of $5.00 for subscription to the Journal of the American Peat Society during the first year is inclosed. It is understood that the payment of this sum will admit me to the society and entitle me to all the privileges granted to members by the constitution. This action is prompted by my interest in the utilization of peat and the welfare of the society.

Yours very truly,

---------- (Signature)

---------- (Address)

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The publication of articles in this journal should not be considered an endorsement of them by the society or its officers. Manuscripts sent for consideration by the editor should be registered. Written discussions of papers are invited. Authors wishing reprints of articles are requested to correspond with the editor. Advertising rates will be furnished upon application to the secretary.

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ANNOUNCEMENT OF SIXTEENTH ANNUAL CONVENTION.

The Sixteenth Annual Convention of the American Peat Society will be held on August 29, 30, and 31 at South Bend, Indiana.

South Bend was selected by the Executive Committee because of its proximity to the great peat deposits of the Lake States and to the peat experimental tract of the Bureau of Plant Industry. At the last annual convention in New York City Professor J. H. Beattie, Horticulturist, United States Department of Agriculture, outlined the excellent results that had been obtained in the growth of sweet corn in this region. It is planned during the convention to make several trips to peat experimental fields near South Bend and to thus see at first hand the products that can be raised by means of peat and muck land agriculture.

The program has not been completed and can not therefore be announced at this time. Sufficient progress has been made, however, to state that speeches will be made by prominent statesmen of the Great Lakes region on the economic value of peat and papers will be presented by representatives of federal and state bureaus that deal with peat. Copies of the program will be mailed to members in the near future.

All members and other persons interested in peat or muck should plan to attend.

PEAT INDUSTRY IN 1921.

By K. W. Cottrell,
United States Geological Survey.

The peat industry in the United States reflected the general business depression in 1921. In common with all other raw fertilizer materials peat suffered by reason of the decrease in the selling price of agricultural products, which, combined with the high freight rates, prevented farmers from purchasing fertilizer. Many of the operators were idle during the whole year; others operated but a few months.

The quantity of peat produced in the United States in 1921 decreased 42,798 short tons, or 58 per cent; the value decreased $661,613, or 72 per cent. Peat used in the manufacture of fertilizer decreased 33,812 tons, or 53 per cent, in quantity and $552,589, or 68 per cent, in value. Peat used in the manufacture of stock food decreased 93 per cent in quantity and 96 per cent in value. A small quantity of peat fuel was reported for 1921.

Peat produced in the United States, 1916-1921.

Year.	Number of plants reporting.	Short tons.	Value.	Average price.
1916	13	52,506	$369,104	$7.03
1917	18	97,363	709,900	7.29
1918	25	107,261	1,047,243	9.76
1919	15	69,197	705,532	10.20
1920	18	73,204	921,732	12.59
1921	21	30,406	260,119	8.55

The 21 plants reporting production in 1921 were distributed as follows: New Jersey 4, New York 4, California 3, Illinois 2, and Florida, Georgia, Massachusetts, Michigan, Minnesota, New Hampshire, North Carolina, and Wisconsin 1 each. California was the largest producer, with an output of 12,672 short tons, valued at $117,580. New Jersey ranked second, with an output of 12,051 tons, valued at $94,269. Illinois ranked third, but the State total may not be published, as there were only two producers.

The quantity of peat moss or litter imported in 1921, according to the Bureau of Foreign and Domestic Commerce, was 3,450 tons, an increase of 688 tons, or 25 per cent, over

1920. The price per ton, however, fell from $13.11 to $6.60. No exports of crude peat or peat products were reported for 1921.

The consumption of peat and peat moss (production plus imports) was 33,856 tons, valued at $282,873, in 1921, against 75,966 tons, valued at $957,933, in 1920.

Peat and peat moss used in the manufacture of peat products in the United States in 1920 and 1921.

Kind of product	Production. Short tons	Production. Value.	Imports Short tons.	Imports Value.	Consumption. Short tons.	Consumption. Value.
1920.						
Fertilizer and fertilizer ingredient	63,272	$773,635	.....	.....	63,272	$773,635
Stock food	a 9,182	a 143,047	.....	.....	a 9,182	a 143,047
Fuel and miscellaneous products	750	5,050	.....	.....	750	5,050
Moss	(a)	(a)	2,762	$36,201	a 2,762	a 36,201
	73,204	921,732	2,762	36,201	75,966	957,933
1921.						
Fertilizer and fertilizer ingredient	29,460	251,046	.....	.....	29,460	251,046
Stock food	b 946	b 9,073	.....	.....	b 946	b 9,073
Fuel	(b)	(b)	.....	.....	(b)	(b)
Moss	(b)	(b)	3,450	22,754	b 3,450	b 22,754
	30,406	260,119	3,450	22,754	33,856	282,873

(a) Small production of moss and stable litter included under "Stock food."
(b) Small production of fuel, moss, and stable litter included under "Stock food."

The following individuals and companies reported to the Geological Survey that they produced crude peat products in the United States in 1921:

Alphano Humus Co., 2 Rector St., New York, N. Y.
Appleton Peat Products Co., Appleton, Wis.
Blaine, J. H., Hopewell Junction, N. Y.
Chapman, I. S.,&Co.(Inc.), 937 Third Street, San Bernardino, Calif.
Craig, William H., Fishkill, N. Y.
Day, James H., 35 South Street, Milford, N. H.
Hennepin Atomized Fuel Co. 406 Tribune Annex, Minneapolis, Minn.
Humus Natural Manure Co., 1964 Broadway, New York, N. Y.
Hyper-Humus Co., Newton, N. J.
International Products Co., 132 Boylston Street, Boston, Mass.
McElhone, Asa, Fishkill, N. Y.
Manito Chemical Co., Peoria, Ill.
Marcrum, J. G., Netcong, N. J.
National Humus & Chemical Co., Chassell, Mich.
Pacific Humus Co., 205 Central Building, Pasadena, Calif.
PhosPho Germ Manufacturing Corporation, New Bern, N. C.
Ranson, Robert, St. Augustine, Fla.
Riverside Orange Co. (Ltd.), Arlington Heights, Riverside, Calif.
Sims, Alfred F., Sag Harbor, N. Y.
Southern Humus Co., Smyrna, Ga.
Wiedmer Chemical Co., Pierce Building, St. Louis, Mo.

SOME RESULTS FROM FERTILIZERS ON MUCK SOILS.[1]

By M. M. McCool and Paul M. Harmer,
Soils Section Michigan Agricultural Experiment Station.

The use of fertiliers on muck lands has been strongly advocated by chemists, and soils and crops investigators in several states, notably, Michigan, Illinois, Indiana, New York, Wisconsin and Minnesota. It is recognized that some of these soils run very low in lime and respond to its application while others carry large amounts and thus do not need it. Some likewise soon become deficient in potash while others produce satisfactory yields of crops for a number of years without the use of this fertilizer constituent. Doubtless the use of some carrier of phosphoric acid along with potash is sound practice on many soils. It has been reported by Whitson of Wisconsin and Alway of Minnesota, however, that phosphoric acid is the chief limiting condition in crop production in the case of some peats.

It is not only desirable to know the elements of plant food that are lacking in such soils but also the proper amounts to apply as well as the frequency of application. Several co-operative experimental and demonstrational fertilizer projects were conducted on muck soils this year and it is planned to continue certain of these and put out several additional ones. In this report we are presenting the main points that have been brought out by this season's work. Later on a more comprehensive report will be made public.

Pasture Fertilization

One of the problems of muck land owners, which is under investigation, is not only to increase the yield of pasture but also to raise the nutritional value. Where 200 pounds of muriate of potash were applied to new, deep muck the yields

[1] These investigations were made possible by the splendid co-operative spirit manifested by the owners of the land upon which they were conducted and by County Agents Decker, Eckard and Simanton. Mr. Ezra Levin made arrangements with the co-operators and was largely responsible for the conduct of the work until July 1st. Mr. J. F. Crum also deserves much credit for the preparation of materials for shipment and applying them to the land and assisting in the harvesting of the crops. Mr. A. G. Weidemann assisted in the harvest and in making sugar and other determinations.

of bluegrass, taken in September were found to have been increased 155 per cent and where the same amount of potash and 250 pounds of acid phosphate were applied it was raised

Fig. No. 4—The proper fertilization of muck soils for pasture production deserves much consideration. This photograph shows the comparative yields of blue grass on September 2nd, grown on deep muck. No. 1.—Unfertilized, No. 2.—200 pounds of muriate of potash, No. 3.—200 pounds of muriate of potash and 250 pounds of acid phosphate per acre respectively.

245 per cent. The fertilizers were applied to the land early in the spring. In as much as a large area of muck land is utilized for grazing purposes these results are valuable in suggesting methods for their improvement.

Sweet Clover.

Biennial white sweet clover yielded well on some areas the first season while on others the yields were unsatisfactory without fertilization. The results show that this crop is at a disadvantage when weed growth is vigorous in the spring. In one instance the unfertilized portion of a field, composed of muck to the depth of seven feet, yielded 960 pounds of hay per acre; the addition of 250 pounds of 16 per cent acid phosphate resulted in a yield of 2,780 pounds; 200 pounds of muriate of potash resulted in a yield of 1,600 pounds and where a combination of these was used 2,960 pounds. In the case of another virgin, deep muck the addition of either manure

or fertilizers resulted in very slight increases, if any, in the yield of clover hay, the unfertilized portions producing 4,265 pounds per acre.

Sunflowers.

Sunflowers are a promising crop especially where frost conditions are bad, in as much as it is more resistant to frost than are the varieties of corn that are at the disposal of the grower at the present time. This crop is very sensitive to lack of potash in the soil and may be used to a decided disadvantage in determining this deficiency. The field observations this season brought out that this plant is especially useful in smothering out weeds, such as thistles and others and is reported to be valuable in combating quack grass. The yields on the four untreated portions of the field owned by E. W. Kingery, near Buchanan, averaged 10.1 tons per acre whereas the addition of 200 pounds of potash resulted in the yield of 25.4 tons.

Corn.

The corn crop is a favorite where the frost conditions do not prevent its production. This crop is sensitive to a deficiency of potash in muck land and where such is the case the stalks do not reach sufficient height and usually turn yellow and break down before the time of maturity. Frequently such

Fig. No. 5.—Corn is very sensitive to a deficiency of potash in muck soils. Corn shown in the left of photograph is unfertilized, well drained muck land; that in the right on land which received muriate of potash at the rate of 200 pounds per acre.

conditions are erroneously considered to be indicators of t presence of some plant diseases or insect pest. If phosphorus is not present in suitable amounts the yields are not what they should be. Where the variety known as Wisconsin No. 25 was grown on unfertilized muck land owned by Mr. T. H Graham near Lum, the yield of grain was 9.5 bushels, and stover 900 pounds. Where 200 pounds of muriate of potash was used the yield of grain was 68.9 bushels and stover 3780 pounds and where 200 pounds of potash and 250 pounds of 16 per cent acid phosphate were applied the production of grain was 70 bushels and stover 4320 pounds per acre.

Fig. No. 6.—Sunflower stubble on muck land. Figures 6 and 7 represent adjoining strips in the same field, which were plowed, fitted and cultivated in the same manner. This shows the possibilities of sunflowers in smothering weeds.

Sugar Beets.

The sugar beet on muck land is receiving considerable attention. The questions of tonnage production, purity and sugar content of beets grown on muck land have been leading ones for some time. These are being considered. The tonnage and composition of beets grown on muck land owned by T. H. Graham near Lum, Michigan, are given in Table 1. The final samples for study were collected on October 29th.

These results show in brief that the tonnage of sugar beets produced on this soil is very low unless it is fertilized.

The most striking deficiency is potash, phosphoric acid is also needed by this soil, while the use of nitrate of soda with the potash and phosphoric acid results in some increase in the tonnage of this crop. The sugar content of the beets was appreciably increased by the addition of potassium and a combination of this element and phosphorus increased it still further. The addition of nitrogen did not affect the sugar content so much, whereas both the yield and sugar content were raised by the use of manure.

Fig. No. 7.—Corn stubble on the muck plat. Compare weed growth with that shown in Figure No. 6.

Table 1. Tonnage and composition of sugar beets grown on T. H. Graham muck, Lum, Mich.

Soil Treatment	Yield per acre		Sugar in beets		Purity
	Tops Tons	Roots Tons	Sept. 27 Per cent	Oct. 28 Per cent	Oct. 28 Per cent
N	4.1	3.7	12.5	12.3	80.6
P	3.6	3.2	12.8	12.9	85.2
K	6.1	12.3	13.6	14.1	83.8
Untreated	5.2	3.5	11.1	10.8	79.2
N & P	5.6	4.5	14.3	11.2	71.8
N & K	5.5	16.6	16.5	15.8	87.8
K & P	5.2	14.1	16.5	15.9	88.8
N & K & P	5.1	16.2	15.5	16.2	85.8
M	4.7	15.5	15.6	14.8	87.9
M & P	5.3	15.6	14.7	14.3	83.2

*In this and the following tables—
O—No treatment.
N—Sodium nitrate—100 pounds per acre.
P—Acid phosphate—250 pounds per acre.
K—Muriate of potash—200 pounds per acre.
M—Manure—12 loads per acre.

Table 2. Tonnage and composition of sugar beets from DeCamp muck, Imlay City.

Soil Treatment	Yield per acre		Sugar in beets		Purity
	Tops Tons	Roots Tons	Sept. 27 Per cent	Oct. 28 Per cent	Oct. 28 Per cent
N	6.5	7.0	12.1	15.1	83.9
P	11.1	7.7	10.5	14.2	82.9
K	7.4	8.3	13.2	15.5	88.1
O	7.4	6.5	13.9	14.2	85.3
N & P	11.3	7.3	13.0	14.4	83.5
N & K	6.5	5.6	12.7	14.9	81.0
P & K	9.6	7.5	12.9	14.2	83.4
N & P & K	10.7	8.7	15.1	13.3	79.6
O	5.5	5.3	11.5	14.6	81.0
M & P	10.9	9.1	12.7	12.6	81.1
M	8.6	10.4	12.9	15.3	85.8

The tonnage of leaves on the sugar beets from Imlay City was appreciably increased by the addition of acid phosphate yet the yield of roots was not so strikingly raised. On the other hand muriate of potash did not cause an increase in leaf development but increased the root production. Nitrate of soda when used alone did little, but when combined with the muriate of potash and acid phosphate its influence was

Table 3. Tonnage and composition of sugar beets from Thorpe muck, Eaton Rapids.

Soil Treatment	Yields per acre		Sugar in beets		Purity	
	Tops Tons	Roots Tons	Sept. 24 Per cent	Oct. 25 Per cent	Sept. 24 Per cent	Oct. 24 Per cent
M.	8.8	22.5	12.6	13.7	82.3	84.1
P. & K.	7.9	23.8	12.2	13.4	81.9	85.0
O.	4.5	13.5	10.9	12.5	80.0	82.5
K.	11.7	32.3	11.9	12.6	81.5	77.3
P.	5.7	18.5	13.3	12.2	85.3	81.7

notable. The highest sugar content of beets on Sept. 27 was obtained from this plot, the lowest being from the beets grown on the land that received acid phosphate alone. On Oct. 28, the differences were less marked.

Although the Thorpe muck was newly broken and had been neither cropped nor pastured, yet its fertilization with either muriate of potash or acid phosphate or manure increased the tonnage of beets markedly. The sugar content and purity were not strikingly affected by fertilization.

Table 4. Yield and composition of sugar beets from Sherman muck, Homer, Michigan.

Soil Treatment	Yield in acre roots—tons	Sugar in beets per cent	Purity per cent
O.	12.7	15.0	88.8
L.	12.6	14.2	83.9
L & P & N & K	17.9	13.5	82.0
L & P & K	16.9	14.2	82.3
L & M	17.0	14.4	83.0
M.	17.5	15.0	86.0
O.	12.6	14.1	84.0
P.	13.4	13.0	82.9
N.	13.3	12.8	84.0
K.	15.9	14.1	85.0
O.	9.8	14.3	86.0
N & P	11.0	13.5	83.5
N & K	16.3	13.6	82.9
K & P	17.4	15.2	85.0
N & P & K	15.4	14.7	86.2
Average of untreated plots	11.7	14.4	86.5

The tonnage of beets on the Sherman muck was increased by all treatments although the effect from the application of either nitrate of soda or acid phosphate were far less than were those brought about by muriate of potash or manure. Obviously this soil does not need lime for this crop.

The sugar content was the lowest in the beets grown where sodium nitrate alone was used and it was found to be the highest in those grown on the plots which received acid phosphate and muriate of potash. The sugar content was almost as high in the first untreated plat as it was in the treated portions. The "purity" was not raised but lowered somewhat by fertilization.

DISINTEGRATION OF CEMENT TILE IN PEAT.[1]

By F. J. Alway.

Introduction.

In a recent publication (6) there is a description of the disintegration of cement tile laid in a Wisconsin marsh and the conclusions are drawn that "peat disintegrates some cement tile" (6, p. 32) and that "the action of the acids of the peat is the most probable cause of the disintegration" (6, p. 29),although the description given of the marsh seems to leave no doubt as to there being an abundance of lime in the peat. It would be more in accord with our present knowledge of the composition and properties of peats to conclude that **some** peats are able to disintegrate cement tiles, as the latter are now commonly made, and in the case of high-lime peats if any acid has caused injury to the tile to attribute this to the oxidation of associated iron sulphide rather than to the action of organic acids. It appears that cement and concrete may be safely used in some peats while in others they are to be avoided, the determining factors being the chemical character of the peat itself and the presence of iron sulphide in the peat or underlying muck and of soluble salts of sodium and magnesium in the drainage water.

In 1910, Tacke, Director of the Bremen Peat Experiment Station, published in the Mitthielungen des Vereins fur Forderung der Moorkultur an excellent article on the disintegration of concrete in peat (13), but this was not abstracted in the experiment Station Record and appears to have escaped the attention of American drainage engineers.

In Germany, at the time Tacke's article was written, so much importance was attached to the question of the behavior of concrete structures in peat soils that a special sub-committee of the Deutschen Eisenbeton-Ausschuss, (German Committee on Reinforced-Concrete) had been created to which was assigned the task of investigating the behavior of cement in peat soils under different conditions

[1] Published with the approval of the Director as Paper No. 312, of the Journal Series of the Minnesota Agricultural Experiment Station.

(13, p. 234). This sub-committee promptly began its work, carrying out a great number of experiments in different bogs to study the action of peat soils and of bog waters upon samples of cement and concrete under different conditions. The publication of the report of the committee was delayed by the war, but Tacke, in a recent communication to the writer, states that it will soon appear.

Peats Not All Alike.

The disappointing experiences of the Prussian Government in its attempt to reclaim large tracts on the Hanoverian bogs led to the discovery that not all peats are alike from the reclamation standpoint, and to the founding in 1877 of the first peat experiment station in the world—that at Bremen. Within a very few years it was found that peats form two main groups according to their content of lime, and that the great Hanoverian bogs are very deficient in this, while the bogs upon which the Rimpau system, perfected in 1862, had proven so satisfactory were rich in lime (1, p.40).

German drainage engineers, however, did not quickly recognize this difference in peats as it might affect their problems. Thus in Vogler's Grundlenren der Kulturtechnik (14) it is repeatedly assumed that in the case of all peats cement tiles, conduits, culverts and checks are attacked by humic acid. "Cement tile are but little or not at all resistant toward bog water" (14, p. 142). "If the soil is strongly acid and especially rich in humic acid the durability of the cement tiles is very limited. They are then attacked to such an extent that they soon soften to a pulp and then fall to pieces. . . Accordingly by presence of humic acid cement tiles should never be used. They are for this reason not suitable for the drainage of peat lands" (14, p. 478). He also states that cement and concrete structures should not be used for dams or checks in peat lands. (14, p. 510.)

High-Lime and Low-Lime Peats.

Peat soils, when considered from the standpoint of the chemical treatment needed to make them productive, fall into two great groups—**high-lime** and **low-lime peats.** The former

include all those which may be made productive of the ordinary farm crops without the application of any form of lime, while in the reclamation of the latter liming is an indispensable first step. Differences in the content of lime characterize the groups. On the basis of data on Minnesota peat soils the former may be regarded as including those with 1.20 per cent or more of lime (CaO), as determined by incineration of the peat and extraction of the resulting ash with aqua regia. To the low-lime group belong the peats with less than 0.80 per cent. Too few peats of the intermediate group, embracing those with a natural content of 0.80 to 1.20 per cent of lime, have been encountered to permit of their difinite classification, and for convenience they may be considered as **peats of doubtful lime requirement,** and to be classified only on the basis of a vegetation or field experiment.

One instance af a Minnesota peat of doubtful lime requrement might be cited. In this the lime content was only 1.00 per cent and the reaction by the Truog test moderately acid A field experiment on the bog, however, using various crops, gave no evidence of any deficiency of lime (3).

Swedish experience indicates that in the case of peats with a lime content of 1.00 to 1.30, or thereabouts, the actual content of lime is not a safe guide to the lime requirement this being influenced by the degree of decomposition and possibly also by other conditions.

Humic acids are not carried in the bog water of high-lime peats. These acids are more or less soluble in pure water and in weak mineral acids, as phosphoric and boric, but insoluble in hydrochloric and sulphuric acids. With soluble compounds of calcium, magnesium ,iron and aluminum, they form insoluble compounds, so called "humates," which are insoluble in water as well as in moderately concentrated alkali solutions. The clearness of calcareous waters that have come into contact with peat or peat soils is due to the insolubility of the calcium humates. (16, p. 217)

Causes Of Disintegration Of Cement and Concrete in Peat

The possible causes of disintegration of concrete which should be considered in connection with tile lines laid in peat below the action of frost, may be placed in four groups:

1. **Humic acids,** whether these be regarded as actual acids in solution in the bog water or as colloidal matter in suspension.
2. Iron sulphide (FeS2,) as either pyrite or marcasite, occurring in either the peat, especially the lowest layers, or in the underlying muck.
3. Hydrogen sulphide.
4. "Alkali waters."

Action of Humic Acids—It has long been known that the peat of many bogs shows an intensely acid reaction. Until recently it was generally accepted that this was due to the presence of very slightly soluble organic compounds of definite but undetermined composition, and these were referred to as **humic acids** while the products obtained by neutralizing them with bases were known as **humates.** The water from such bogs shows various characteristics of acids, liberating hydrogen with metals and carbon dioxide from carbonates, and also decomposing insoluble phosphates and silicates. In recent years, however, it has become a subject of much controversy as to whether the acid characteristics both of such bog waters and of the peat itself are not due rather to the expression of the colloidal properties of compounds in the peat, some of which are held in suspension in the water (8.)

It has also been recognized that concrete in contact with these strongly acid peats and bog waters is somewhat attacked but it is still uncertain how serious the disintegrating action may prove. Tacke (13) states that where the acid-reacting water has a rapid current it may wash away the insoluble humate as fast as it is formed with the lime of the cement, leaving the gravel loose and exposing a fresh and roughened surface of the concrete for further attack, and in course of time this might have really serious consequences. Tiles, culverts, wiers and the piers of bridges would be especially exposed to such action. On the other hand where there is only a very slow movement of the water, which can carry at most only very small quantities of the humic acids in solution or in suspension, the coating of humates may be expected to serve as a protective layer. Bersch states that with the foundations of buildings "an especially strong action of

the acid bog water is not to be feared (in contrast to conduits of concrete), because here only a very slow movement of the ground water takes place." (4, p. 301.)

The very slight penetration of the acid water is evidenced by observations on both glacial boulders that have lain in the acid bogs for thousands of years and on lumps of coarse marl remaining from applications made in connection with agricultural reclamation. Tacke mentions finding, years after the marl had been applied, such lumps covered with only a thin brown rind of the reaction products while the center was still white and unchanged, but concludes that "we must first experimentally gather further evidence, before we can decide upon the general use of cement in strongly acid (peat) soils." (13, p. 238.)

Bersch of Austria, in his excellent book on peat soils, writes regarding the use of cement tiles in peat soil:

"These may be used only in the low-moors, because the acid-reacting waters of the high moors strongly attack cement and very quickly destroy it." (4, p. 79.)

The peats of the high moors belong to the low-lime group while those of the low moors, with only an occasional exception, belong to the high-lime group.

It is not at all certain that the percentages of lime that differentiate peat soils in agricultural reclamation apply in questions of the attack upon cement of the bog water or of the peat itself. Thus the peat in Minnesota referred to above, which carried 1.00 per cent of lime and showed a distinctly acid reaction, but produced as good crop yields without as with lime, might attack concrete tiles. However, as only a very small proportion of all peats belong to this **group of doubtful lime requirement**, most peats being either distinctly high lime or as distinctly low lime, the question is not of great practical importance.

Action of Iron Sulphide—The occurrence of iron sulphide in peats and its oxidation upon exposure to the air has been known for more than a century, as evidenced by Rennie in 1810 describing "pyritous, or vitriolic peat." (9, p. 640.)

Tacke in his article referred to above has dealt fully with the action of the oxidation products—sulphuric acid and fer-

rous sulphate—upon concrete. Rost has made a somewhat detailed study of the occurrence of the sulphide in the peats of northwestern Minnesota (10), and the writer has dealt with the subject in so far as it affects the agricultural reclamation of such soils. (1, p. 63.)

The sulphide occurs in the form of both pyrite and marcasite, which are alike in chemical composition (FeS2.) These are quite similar in appearance but differ in crystal form and somewhat in color and specific gravity. The pyrite forms isometric crystals, and is pale brass yellow in color while the marcasite is orthorhombic and paler in color, a pale bronze yellow, inclined to a green or grey, and slightly lighter. The marcasite oxidizes more readily, and so with this there is greater danger of a harmful concentration of the oxidation products. (13, p. 236.)

While neither of their oxidation products—sulphuric acid and ferrous sulphate—are found mixed with carbonates, the iron sulphides are quite stable in contact with these, quite commonly being found in mineral veins along with calcite, as well as in peats abundantly supplied with lime. In both cases on exposure to the atmosphere in the presence of moisture the reaction $F_eS_2 + 7O + H_2O — F_eSO_4 + H_2SO_4$, produces products which react with the carbonates to form gypsum and basic ferric oxide.

$$H_2SO_4 + C_aCO_3 + H_2O = C_aSO_4, 2\ H_2O + CO_2$$

$$2\ F_eSO_4 + 2\ C_aCO_3 + 2\ H_2O + O = 2\ C_aSO_4, 2\ H_2O + F_{e_2}O_3 + 2\ CO_2.$$

The result is that the pyrite and marcasite on exposure to the air form centers of decomposition for the associated carbonates and of disintegration for adjacent materials such as concrete in which fragments of a more or less inert material are cemented together by readily attacked calcium compounds.

Tacke (13, p. 234) mentions the case of a cement drainage conduit which in 1903 had been laid partly in the peat of a very deep, well decomposed low-moor in the valley of the Haase River near Osnabruck, in Hanover. After only a half year's use serious injury was observable on both the inside and the outside. At the level of the water table the cement

was more or less eaten away, in many places entirely destroyed so that the gravel that had been mixed with the cement could be easily removed from the softened mass of concrete, and an abundance of yellow, cheeselike precipitate was observed. The cause of the injury was found to lie in the high content of pyrites in the peat soil—it reaching as high as 17 per cent at the place showing most injury. In filling the ditch after the conduit had been completed the latter had been covered with the excavated peat—the pyrite in this on oxidation providing most of the sulphuric acid and ferrous sulphate which caused the injury. In the soil water there was found from 8 to 87 mgs. of free sulphuric acid per liter and in samples of the soil 21 per cent of ferrous sulphate and from 4 to 8 per cent of free sulphuric acid. Even five years later, in 1909, these oxidation products were still found; after a heavy rain ferrous sulphate and free sulphuric acid were found in large amounts in the pools of water collecting on the surface at the spots where the abundance of pyrite had previously been found.

Tacke, while recognizing that there is danger for cement structures of every kind wherever iron sulphide occurs in large amounts in peat soils and there is a possibility of its oxidation, points out that "fortunately such large amounts of iron sulphide as were found in Osnabruck are comparatively rare" and further that the form of occurrence deserves consideration as pyrite undergoes oxidation in the presence of the air much more slowly than marcasite. Other things being equal, the slower the oxidation the less danger there will be of a dangerous concentration of harmful products. Finally, as he points out, the ground water relationships play a deciding part, as if the iron sulphide remains at all times below the surface of the water-table and so is protected from oxidation there will be no appreciable formation of the harmful compounds from the action of the oxygen dissolved in the water. He considers that injury to cement structures arising from iron sulphide is excluded when this is confined to those layers of the soil which the ground water protects from aeration, but that the danger will be serious wherever a depression or fluctuation of the water table will permit aeration.

and the more thorough the aeration the greater will be the danger. However, as the formation of the harmful substances proceeds only slowly, even in the presence of an abundance of oxygen, frequent fluctuations of the water-table, will lessen the danger by preventing the formation of concentrated solutions (13, p. 236.)

Whether at any particular place injury should be feared can be decided by a careful examination of both soil and ground water conditions. Sites at the average water level are most to be feared and for these special precautions to protect the cement should be considered.

Action of Hydrogen Sulphide—Tacke (13, 238) calls attention to the need of considering hydrogen sulphide as one of the things liable to injure cement laid in peat. This gas may form in the deeper, non-aerated layers of every kind of peat as well as in mineral soils rich in organic matter. By its action upon the lime of the cement calcium sulphide is formed. This is insoluble in water but is gradually changed into the soluble calcium sulphydrate which in turn is oxidized by the atmospheric oxygen to gypsum. The slower the movement of the air the greater the danger of injury from hydrogen sulphide, as by free access of the air it is rather rapidly oxidized to sulphur.

Tacke (13, 239) observed further that hydrogen sulphide may react upon the iron compounds of the cement to form iron sulphide, with an accompanying loosening of the structure of the concrete. Later, on contact with the atmosphere, the iron sulphide forms oxidation products, with the disintegrating action mentioned in the preceding section.

It still seems doubtful whether any serious injury to tiles should be feared from hydrogen sulphide. Tacke regards this as far less important than either the humic acid or the iron sulphide and in the upper drained and aerated layers as not to be feared (13, p. 240.)

Action of Alkali Waters—Much study has been devoted in recent years to the injury of concrete by "alkali waters" in which sodium sulphate, magnesium sulphate and magnesium chloride appear to be chiefly responsible. These reacting with the compounds of calcium either form compounds hav-

ing larger molecular volumes, with the result that there follows an expansion and resulting disintegration of the concrete, or form soluble calcium salts which are carried away in solution, (5, 11, 12 and 15.) While some writers do not seem to definitely recognize the gypsum content of the soil or soil waters as innocuous it seems self evident that any calcium sulphate in the water may be ignored, the cement itself carrying several per cent of gypsum.

Gypsum is not at all uncommon in high-lime peats and in northwestern Minnesota in dry weather in many places it separates out on the surface of the bogs as a thick crust crackling under the foot. (2, p. 94.) It may be expected on any drained bog which in its wild condition carried iron sulphide in its lower layers.

The presence of sulphates and chlorides of sodium and magnesium, however, appear to have not been reported in bog waters.

Precautionary Measures.

It would appear that cement tile may be used without risk in high-lime peats that are free of iron sulphide, but are subject to attack and possibly to disintegration in low-lime peats.

At the Coon Creek (Minn.) peat experimental field cement tile of poor quality were laid in 1918 in the high-lime peat (about 3.0 per cent CaO,) in which sulphides are to be found in some places. Three years later an examination of the limes showed that some of the tile had been slightly attacked but not to any serious extent. At the Grand Rapids (Minn.) sub-station cement tile were laid in 1910 in a typical low-lime bog, of which the peat at all levels carries from .50 to 0.80 per cent CaO. The tile lines are still working satisfactorily. On neither bog, in putting in the drains, were any precautions taken to protect the tile.

When encountered in the high-lime peats the iron sulphide is ordinarily found in quantity only in either the lowest layer of the peat or in the underlying muck and hence these are the layers to be examined. If the surface layer of a bog is found high in lime the underlying layers also will be well supplied and hence the only tests needed will be for

iron sulphide, or its oxidation products, at the bottom of the ditches where these are near the line of contact of the peat with the mineral substratum, and for alkali in the drainage water. If the tiles are laid where the bog is so deep that peat extends several feet below the bottom of every ditch the iron sulphides are not to be feared.

In those parts of Minnesota where sulphides at the bottom of bogs have been found most common not only is the peat well supplied with lime but the mineral substratum is very rich in carbonates. This, if properly used in covering the tiles, might fully serve to protect them from injury even where the sulphide is abundant. Similarly, concrete foundations laid in peat carrying iron sulphide may often be very easily protected by surrounding them with excavated calcareous mineral subsoil. In one part of Minneapolis where many large buildings have been erected on high-lime bogs from 2 to 8 feet deep, the foundations of these buildings rest on a highly calcareous substratum, in some cases first passing through a shallow bed of marl.

A good illustration of the importance of the relative amount of carbonates that may be naturally associated with the iron sulphide is furnished in a study by Fendler and Frank (7) made soon after the destruction of the cement drains at Osnabruck, referred to above, had been reported. A building site on a bog in the city of Berlin was being examined to decide whether concrete might safely be used as a foundation. In the course of the work they took 40 samples of soil, most of them being peat, and in these determined the amounts of iron sulphide, which was found to vary from 0.035 to 5.1 per cent of the dry weight. In the case of each sample a part , spread out in a shallow dish, was exposed to the air for two months, moistening daily with water, to facilitate oxidation of the sulphide. In the case of none of the samples did an acid reaction develop; accordingly there was no formation of free sulphuric acid. Surprised at this, as they had previously found in the case of another set of samples, also taken in Berlin and carrying much less sulphide, that an acid reaction developed even after a short exposure, they sought the explanation and found it to lie in the high con-

tent of carbonates carried by the samples, this more than sufficing to neutrtalize all the acid formed.

In studies of the action of peat upon cement tile the lime content of the layers in contact with the tiles and the presence or absence of sulphates should be reported. For the latter purpose numerous samples taken at short intervals along the bottom of the ditches should be subjected to the well known qualitative tests for sulphides, and in case there has been opportunity for oxidation these should be tested also for both free sulphuric acid and ferrous sulphates.

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DURABILITY OF CONCRETE TILE IN PEAT.[1]

By John T. Stewart, C. E.

As early as 1909 attention was called to the possibilities of the disintegration of concrete tile laid in peat. Reports indicate that individual tile taken from ditches which extended into, or across peat bogs, occasionally showed that while the tile in the mineral soil were sound, the grains of sand were loose, and either fell or could be rubbed from the surface of the tile taken out of the peat. The loosening of the aggregate began on either the exterior or interior surface of the tile wall, and as it proceeded the surface became roughened or pitted, and in some instances the walls were completely destroyed. Failures of concrete tile in peat have been rather rare and they seldom attract attention, although investigators have given the subject some notice. The cause of the disintegration has been attributed to acid generated by the decaying vegetation which destroys the cohesion of the cement, permitting the aggregate to fall apart. Some of the investigators express the opinion that the action would occur on poorly fabricated tile in any peat, while others intimate that the durabilty of any concrete tile in peat might be questioned.

Humic Acid Disintergation Unsatisfactory Explanation

The explanation that the disintegration is due to humic acid, or acid generated in decaying vegetation, is not satisfactory even though the action is confined entirely to poorly fabricated tile. The change from sound to crumbling tile in a trench on entering a bog from mineral soil would be self evident proof that the elements of destruction were contained in the vegetable soil, were it not the exception, rather than the usual condition, to find any change in tile durability in the peat bog. Where there is visible evidence of a change

[1] Dr. F. J. Alway showed the writer the manuscript of the preceding paper, and suggested that he describe the tile lines at Grand Rapids and Coon Creek, and discuss the subject from the drainage engineer's standpoint in the same issue of the peat journal.

Since this paper is a discussion of up-to-date American experience relative to the data in the preceding article by Dr. Alway, the term "cement tile" is designated by the later and more preferable terminology "concrete tile."

in durability the disintegration may be advanced farther in a few months in one bog, than in the same number of years in another bog, or even in another part of the same bog. Again if the destructive force was a common acid product of decaying vegetation the more intensely acid the bog the more rapid would be the work of disintegration, which is not consistent with the facts. Concrete tile in as advanced stages of decomposition for the time they have laid in the peat have been found in the non-acid peats as in the intensely acid bogs. With these facts relative to the field conditions unreconciled it was difficult to accept the explanation that the contributory cause of the disintegration action of peat on concrete tile is the result of a common product in decaying vegetation.

A study of Dr. Alway's paper discloses the fact that German engineers have passed through the same experience relative to the disintegration of concrete by peat as is now being experienced by American drainage engineers. Many of the German writers accepted the failure of a few isolated cases of concrete which have been placed in peat as final proof that the disintegrating force is a common product of decaying vegetation, and that concrete would fail in all peat The literature quoted by Dr. Alway would indicate that some of the German failures had occurred on concrete structures cast in place and some of it may have been of doubtful quality.

Tacke, the German authority on peat quoted by Alway, who has investigated the behavior of cement in peat soils in an endeavor to learn the exact origin of the failures, discovered three primary causes, any one of which may have been the source of the deterioration that had occurred, namely, humic acid, oxidation products of iron sulphide, and hydrogen sulphide. He evidently considered many of the peat soils were as harmless to concrete as mineral soil.

Humic acid is only active in the low lime, or acid peats. These bogs comprise probably only a minor portion of the peat area in the United States, are the ones of least value for agriculture, and will receive only a limited amount of tile drainage for many years. Since the action of this acid may be expected to form a protective coat on any object it attacks, it will only be injurious to the interior wall surface

of a flowing tile where the current removes the coating as rapidly as it is formed. Since the reports on the destruction of concrete tile in peat indicate that the exterior surface of the wall is the one usually attacked, humic acid evidently has been responsible for very few tile failures in the United States, and there is no conclusive proof either in this country, or in the German literature cited, that humic acid has been the direct cause of failure of well fabricated concrete tile.

Iron Sulphide Disintegration.

Iron sulphide (pyrite and marcasite or fool's gold) has probably been the direct source of the serious tile failures that have usually been attributed to acid generated in peat. Undoubtedly,there is a source of danger in placng tile in the presence of iron sulphide; injury from this source is more likely to occur where the tile are laid in the strata which form the contact between the vegetable and mineral soil. It oxidizes slowly in the presence of air and in time will disappear completely from the soil. The crystals are to be detected by inspection, or by the smell of sulphur given off when the strata containing them are burned. Its presence even in considerable quantities is not always deleterious to concrete, as shown by the tests of Fendler and Frank quoted by Alway. It may often be neutralzed by placing top soil, ground limestone, or slacked lime around the tile. The excessive quantities of this material referred to in German literature has never been reported in this country. Dr. Alway states that where strata bearing iron sulphide have been found in Minnesota, both the over and underlying layers of soil are rich in lime, or carbonates that would tend to neutralize the injurious products of oxidation if placed around the concrete.

Hydrogen sulphide, a gas generated in undrained peat, may cause disintegration of concrete, but it is doubtful if concrete tile working fairly well have ever been seriously injured from this source.

The visible appearance of the action of humic acid, iron sulphide and hydrogen sulphide on concrete is the same. Humic acid is destructive only in the presence of a current of water, and both the sulphides when the material generating

it are piled against the concrete; consequently, we might expect the action of humic acid to be visible on the interior of the tile and that both of the sulphides on the exterior. Since the supply of iron sulphide may be exhausted, or the generation of hydrogen sulphide suspended, the action on the tile may be arrested indefinitely at any time. It does not follow that disintegration, even though rapid for a time, may develop to the point of failure. The German investigations into the failure of concrete in peat would indicate that if reasonable precautions are taken there will be no serious failures from laying well fabricated concrete tile in peat bogs of the high line class that it will be profitable to drain in the near future.

Alkali Water.

The action of alkali on concrete has been thoroughly discussed in various publications, and since it occurs in this country in mineral soils, and there have been no reported failures of concrete tile in peat that would indicate the presence of alkali, it will not be further considered.

Tile in Low Lime Peat at Grand Rapids, Minnesota.

The writer, who was in charge of the drainage of the North Central Experiment Station at Grand Rapids, Minnesota, in 1910, placed a car load of concrete tile in a peat bog which varied from 3 feet to 22 feet in depth. As these tile were laid for experimental purposes they were so placed that some of them came at the point of contact between the peat and underlying clay, and others in varying depths of peat up to 22 feet. In 1912 the entire tile system at this station was carefully inspected, under direction of the writer, by the same foreman who was in charge of the laying in 1910. The concrete tile were found in good condition with the possibility of a slight disintegration in some individual tile. In 1915 a line of concrete tile running through the deeper part of the peat was reported as not working; upon investigation it was found that the line had settled for several hundred feet. Water at the point of greatest settlement was sanding 8 inches over the top of the 5 inch tile. To correct the settled section 400 feet was taken up and relaid on a new location in September, 1916. Many of the tile gave evidence of action that

had loosened the aggregate on the exterior surface and caused it to fall away. The tile was carefully inspected and 350 feet of the ones taken up were relaid. Only forty feet out of 400 which had been laid in peat 10 to 20 feet deep were considered unfit for relaying after 6 years of service. In 1921, the writer made another inspection of these tile in the presence of the foreman who had charge of the relaying, and who was one of the tile layers in 1910, and also in the presence of the superintendent of the station, Mr. Otto I. Bergh. The relaid line of tile was found in as good condition as in 1916. The disintegrating action which had occurred between 1912 and 1916, at or before relaying, had not again become active. At one opening just above where the relaying had been discontinued the tile showed evidence of exterior surface disintegration similar to the ones taken up in 1916. One line located 300 feet west, and parallel to the settled line in deep peat was opened at several points and showed no disintegrating action of any nature. Twelve inch tile laid partially in peat and clay were as perfect as when laid. At all other openings the concrete tile were in good condition.

These tile were considered fairly good at the time they were fabricated in 1910, but would not be classed as good tile at the present time. The aggregate was dirty, improperly graded, and the tile made from it is reported to have been unsatisfactory in other localities. The peat in which they were laid is described by Alway as one of the most intensely acid peats found in Minnesota. The 1921 inspection was made eleven years after the tile were installed, and considering the quality of the tile and the acidity of the bog, it might have been expected that these tile would all have been completely destroyed if there is a common product of decaying vegetation destructive to even a poor quality of concrete tile. The only concrete tile laid in this bog which shows any deleterious action after 11 years of service were in a line which was known to have been obstructed for at least a year, and probably was partially obstructed for two or three preceding years. Analyzing the deterioration of this line of tile in the light of the German information, as interpreted by Dr. Alway, the writer suggests that it was caused by hydrogen sulphide generated

after the tile had settled and was submerged in water. The deterioration was arrested when the tile were taken up and relaid where the peat was sufficiently firm to hold them to grade. No deteriorating action had occurred on any of the other lines where the trench retained its grade. Undoubtedly the hydrogen sulphide action was intensified by the poor quality of aggregate and lean mixture used in fabrication, as compared to present day methods of manufacture.

Tile in High Lime Peat at Coon Creek, Minnesota

In 1918 the Coon Creek Peat Experimental Fields on a high lime bog (one that does not require treatment to neutralize acid for crop production) located near Anoka, Minnesota were drained by the use of both clay and concrete tile. These tile were inspected by the writer in August, 1921, and some of them showed a slight action, to the extent that they were roughened, and grains of sand could be rubbed from the exterior surface. As Dr. Alway has previously stated, they had not been disintegrated to any serious extent. The slight action visible on these tile might also be attributed to hydrogen sulphide caused by poor drainage. In 1920 high water flooded a part of the bog and it was a number of weeks before the water table fell below the top of the tile. The tile samples in which the disintegration was visible came from the lower part of the bog on which the water remained the longest. The concrete tile laid on this bog, at the time they were delivered by the contractor, were condemned by the engineer as being too soft for durability. Dr. Alway stated that some of them could be broken by pressure from the foot, but in the absence of better tile they were installed to prevent a delay in other experimental work.

Summary and Conclusions.

The German information made available by Dr. Alway on the disintegration of concrete tile in peat is a real contribution to drainage literature as it makes possible a satisfactory explanation of one of the perplexing problems of tile failure. With the cause of disintegration in peat reduced to well known chemical compounds it becomes possible to investigate the actual injurious effects of each and prepare the nec-

essary remedial measures if such are found to be necessary.

The outstanding feature of these data in the light of the experience of laying concrete tile in peat is as follows. Many bogs contain no deleterious material, and tile will be as lasting in peat as in mineral soil.

There can be no action on concrete tile by humic acids except in the low lime peats, and the experience at Grand Rapids would indicate that there is no dangerous menace from this source in our most intensely acid peats.

Iron sulphide in the presence of air will decompose concrete, but as it occurs chiefly at the contact of peat with mineral soil, there is little or no danger from this source in deep peat, or in trenches back-filled with material containing lime or carbonates.

Hydrogen sulphide will decompose concrete, but can only be generated in deep, poorly drained peat. The conditions favorable for the generation of hydrogen sulphide in northern latitudes would be favorable for the disintegration by frost and ice of any tile material used. In view of present data concrete tile systems working properly in high lime deep peat are immune to tile disintegrating forces. Examination should be made before laying tile at the contact between peat and mineral soil that precautions may be taken in back filling the trench in case iron sulphide is present.

EXPERIMENTS IN THE MANUFACTURE OF PEAT FUEL AT ALFRED, ONTARIO.[1]

By Aleph Anrep.

Since the coal deposits of Canada are situated in the far east and far west, and a long haul is necessary to bring this fuel to the central provinces, the price of our own coal is prohibitive, and we are dependent upon the United States for the quantity necessary for our comfort and for the maintenance of our industries.

To a certain extent, nature has provided us with abundant, and in some sections of the provinces with excellent, peat deposits for fuel purposes. These are sufficiently important that the Ontario Government, in the beginning of 1918, decided to build an Anrep plant for the exploitation of the peat fuel resources of Ontario. As the Federal Government was planning at the same time to experiment with a new plant devised by E. V. Moore of Peterborough, the Federal and the Provincial Governments agreed to combine their experiments on equal bases of expenditure. On April 24, 1918, a joint peat committee was appointed by the Dominion and Ontario Governments with R. A. Ross of Montreal and B. F. Haanel of the Mines Branch, Ottawa, in charge for the Federal Government, while A. A. Cole of Cobalt, and R. C. Harris of Toronto, were given concurrent authority on behalf of the Provincial Government. For the construction and the erection of the plants, E. V. Moore of Peterborough was appointed the engineer to the committee.

In 1919 these Governments jointly erected two improved types of peat fuel plants at Alfred, Ontario, with the idea of obtaining accurate data as to the most efficient peat fuel plant to be introduced on this continent.

Moore's Peat Machine.

Mr. E. V. Moore of Peterborough has constructed a very ingenious device for the manufacture of air dried peat fuel. It is built very much on the same principles as the invention

[1] Read at the 15th annual convention of the society, New York, N. Y., Sept. 1921.

of Dr. Wielandt of Oldenburg, Germany, which was in operation from 1906 until 1914 in Germany.

The Moore machine operates as follows:

The excavator works in a straight line, excavating a layer from 14 to 16 inches deep and carrying the raw material through a hopper into an Anrep type of macerator. When the macerated peat leaves the mouth-piece, it is carried on a 150 foot endless conveyor belt, running on an arm of fabricated steel, which extends from the main platform of the plant, across the spreading ground. It is located on the opposite side of the plant from the excavator and runs at right angles to the line of the excavated area. The whole plant travels on three caterpillars of which two are placed under the platform of the plant and the third one placed 100 feet from the plant for the support of the belt conveyor arm.

A spreader which spreads at right angles to the working line is operated by a chain belt drive, which runs through the belt conveyor arm to which the spreader is attached, thereby reducing by approximately 10 feet the effective width of the spreader; there is left a spreading field of 140 feet wide. Taking into account the width of the excavation and the width of the spreading area, which corresponds to the amount of excavated material to be spread, and if the machine is to work to the best advantage the spreading area must be sufficiently long that when the field is completely covered, the first row spread will be dried down to the content of 25 per cent moisture and ready for harvesting.

From the above it can be readily seen that a tremendously long working line is required to offset loss of time in our very short working season, for in a short working line the field would be completely covered with the spread peat before the first row would be sufficiently dry for harvesting, and for operations to be begun again from the original end. This system of operation would not be practicable on our average bogs as there are only a very few large peat fuel areas on this continent.

One very useful idea has been incorporated into the machine. After the first row has been used for the operation

of the plant the conveyor is used for conveying the peat from the second row to a track at the end of the conveyor, where the peat is placed in small dumping cars.

There is no doubt that this plant would be a most economical proposition if the disadvantages as described above were not so great, as it requires a labor force of only seven men compared to the Anrep plant which employs thirteen.

Anrep Peat Machine.

This plant has been improved and assembled from the old Anrep type by E. V. Moore of Peterborough according to the new ideas which were left before his death by Aleph Anrep, Sr.

This plant consists of (a) excavator—a triangular platform supported on caterpillars-screw conveyor: (b) a macerator-sixty H. P. boiler round track system dumping cars; and (c) spreader.

The Operation of the Plant.

This excavator is a bucket type, the buckets running inside of loops of the cutting links which are placed on the frame of the excavator about five inches apart. The length of the excavator can be made to suit the depth of the bog. The excavator works along a line parallel with outside of the working trench, and at a slope of forty-five degrees. It is placed on a diagonal frame approximately fifty feet wide and is propelled by rack and pinion. The excavator is operated by 4 in. x 5 in. twin steam engines of 10 H. P. which are placed on the platform. It is hoisted or lowered by a winch and pulley supported by an angle iron frame and operated by a 5 H. P. steam engine.

The capacity of the excavator has surpassed the expectations of the inventor and through careful observation daily for a period of a month the present capacity has been found to be more than twice that of the macerator. It has been demonstrated to have a daily (8 or 10 hour day) capacity of 60 to 80 tons of air dried peat fuel, containing 25 per cent of moisture. The excavator had to excavate from 53 to 71 cubic yards of raw material per hour while in reality it could easily excavate more than twice that amount.

The advantage of such excavation is that all the layers of the peat are excavated simultaneously and a very uniform product is obtained after the peat has been macerated. It also works diagonally, in a 45° angle, leaving a face of the same angle which prevents the edge of the trench from caving in and makes it absolutely safe to carry the complete plant for the next cut. Even after this slope has wintered, the frost has no effect on it.

The excavated peat is dropped into a spiral trough conveyor which runs in full length width and 2½ feet above the rack and pinion track. This trough has an opening in the center to which the excavated peat is conveyed by two spiral screws which work in opposite direction to each other. From this opening the peat is dropped into a similar spiral trough conveyor which is placed at a right angle to the conveyor above and is approximately four feet long; this prevents the large roots passing into the macerator, as they can easily be seen and removed. The peat now is conveyed into the **macerator** and falls on the cutters which oscillate vertically and tear the incoming peat to pieces. The disintegrated peat is then thrown on the shaft provided with a cutter which conveys the material into the machine. The peat after being subjected to this preliminary treatment is conveyed from the working chamber between stationary knives which co-operate with the cutters arranged on both sides of the knives acting like scissors, thus thoroughly macerating the peat. The treated and finely cut peat then enters a long drum, through which extends a shaft provided with kneading arms and which subjects the peat to a very intense after-kneading and more effectively disintegrates it. The completely treated peat leaves the machine through a mouth-piece.

From this can be seen that from the various phases of treatment the peat yields more and more of the water stored up in its cells, the material becomes more thoroughly mixed and homogeneous, and hence reduces the amount of motive power required for driving the machine.

This thoroughly treated product is dumped into dumping cars and conveyed on the circular track system to where it is dumped into a spreader which spreads the peeat in rows

900 ft. x 8 ft. with a thickness of from 5 in. to 6 in. at right angles to the working trench.

The circular track system consists of a specially arranged traction rope in connection with transporting carriages rolling on a movable circular track. The traction rope is so arranged that it can be automatically lengthened and shortened according to the shifting of the circular track sections required to transport the peat to the drying field as the peat excavator advances. The slack rope, after each change, is taken up by an automatic tension apparatus. When the car with its contents of macerated peat reaches the spreader it is received, unhitched and dumped into the spreader. Afterwards the cars are hitched up and continue their circuit to the plant.

The spreader is comprised of a filling frame into which the peat is dumped, the front part of which rests on a caterpillar and the rear part on the moulding frame. The latter is connected with the filling frame by means of a pivot shaft or a hinge so as to be adapted to swing in an upward and downward direction according to the irregularity of the ground and to trail on the field when the apparatus moves forward. At the rear of the filling frame is a mould board which is nearly horizontal and has for its objective the smoothing and moulding of the peat cake without dragging or tearing it into pieces. From here extend outwards 17 dividing tongues provided at the lower surface with 17 knives, which divide the peat row into strips about 6 inches wide and from 5 to 6 inches thick. At the head of the spreader on a platform is a gasoline engine which supplies the motive power for its advancement. As soon as the spreader has completed a line, one section of the rails which are placed at a right angle to the spreading field, and are of the same width as the spreader, are moved on each side of the circular track and the line of rails parallel to the spreading field are moved over, the spreader commences its new spread.

The rows are afterwards cut in a right angle into twelve inch blocks and left on the field to be dried by the sun and wind.

During the one month of observation the whole plant has

proved to be very substantial and symmetric, and a good average production was obtained. However, it must be admitted that the circular track system gave trouble occasionally and the dumping cars had a tendency to jump off the track and create a certain amount of delay. It was also found that the moving of the tracks took a considerable time. Apart from this the plant worked very satisfactorily and there is no doubt that by careful management, and a few additional improvements, it will prove in the long run economical, even considering the short working season, the high cost of labor, and the large number of men employed.

During the writer's fourteen years experience with peat in general in this country, he has found that only 95 days out of the entire season can be used profitably for the manufacture of peat fuel. Anything manufactured over that period has to be left on the field over winter, as the peat would contain moisture far exceeding the amount required for suitable fuel. Of course any peat which has not been properly dried and exposed to rains and conditions of winter becomes unsuitable for the market, as it loses its cohesive properties and disintegrates.

It has been estimated that during the period of 1919, approximately 2,000 tons, and in 1920, approximately 6,000 tons of peat fuel were manufactured by the two plants at Alfred, the greater part of which was produced by the Anrep system.

Some of this peat was sold in Ottawa, Montreal, at Alfred, and other small towns in Ontario, and a great deal was left on the field for the reason, because as reported, cars were not available for shipping. This peat was sold f. o. b. cars, at the Alfred station at $4.00 per ton with a statement that the price is allowing a reasonable commercial profit over and above the cost of production, and including an allowance of 10 per cent for depreciation, and an equal provision for amortization of the plant.

A new program has been laid out for the summer season of 1921 by the peat committee. The Anrep plant will be changed, the circular track system eliminated and in its stead a Moore endless conveyor belt running on an arm of fabricated steel resting on caterpillars approximately 700 feet long, which will transport the peat to a spreader and spread

at right angles to the line of operation of the plant. In other words, it is similar to the principle of the circular track. This idea of a bridge conveyor system is similar to the Baumann type, which was used in 1912-13 on the Royal Bavarian Peat Bog, Rosenheim, Munich, Germany. Critics at that time found that it was very difficult for such a long body to travel over uneven ground and that it gave considerable trouble as there was always something out of order, which decreased the hourly production. However, it is likely that the trouble will be eliminated as the new bridge conveyor will be resting at certain intervals on caterpillar supports and the inconvenience of the shiftable track system will be overcome.

NEWS OF THE INDUSTRY.

Michigan.

Will Study Peat Resources.

The State Department of Agriculture will investigate Michigan's peat resources with a view to enlarging the use of this material as fuel in industrial plants. The report says the Upper Peninsula has thousands of acres of peat which could be utilized to convert minerals into a finished product instead of sending the copper and iron ore east, as now. With the peat beds, water power, limestone and the ore, the department believes the conversion of minerals could take place more largely in this state. With a lakes-to-ocean waterway in the near future the finished products could be shipped to all American and foreign ports.

England.

Peat and Manufactures From Peat in The West of England

By Robertson Honey, American Consul at Bristol, England.

The ancient industry of peat gathering is and, for a long time past, has been carried on in the West of England. At present the industry continues its separate existence and separate identity but it is now also branching out with manufactures of peat into other fuels of which peat forms a component part.

Peat-Fields. The district where peat is gathered is in the neighborhood of Glastonbury, in Somerset. Peat, as is well-known, consists of vegetable matter in an advanced state of decay and is one of the early stages in the development of coal. The peat fields present the ordinary appearance of grazing lands, but about a foot beneath the surface, there are thick layers of peat. A strip of the surface earth and grass about four feet wide is removed from the entire length of the field and, at the depth of a foot or so, the peat present itself in the form of a thick, moist, clayey substance which is ready for cutting.

Cutting. This substance is marked out into squares called "mumps" and they are cut out and placed on boards. The layers of peat that are used for fuel purposes begin at

about five feet below surface. They are then slit up with a specially made peat spade into "turves," or smaller blocks still in a moist and soft state. These remain in the open for about a month for natural drying.

Piling. When sufficiently dry, these blocks are "hyled" or built into small towers so that the wind can further dry them and then the "turves" are stacked into "ruckles" or towers and, later, they are "ricked."

Marketing. The blocks are now ready to be marketed and the ricks are broken from the top. The blocks have been stacked in such a manner that the air and sunlight can pass through the sides of the rick—the blocks are never packed close together in order that they may dry by natural processes. The dampness or dryness of the weather, of course, affects the length of duration of the drying process. When ready for market, the blocks contain but a very small amount of moisture and are appreciably hardened.

Cost. The blocks are sold in lots of 8,000 at £8.15.0 per lot ($42.58 at normal exchanges; $37.62 at present rate.) This quantity is a "rick' and measures 15 ft. x 10 ft. x 7 ft. high. Half and quarter ricks are sold at rates which are slightly higher, in proportion, than price for an entire rick. The quotation given is for consignment free on rail at Ashcott in Somerset; the Company quotes also at 35/- ($8.50 at normal exchange) per ton, free on rail as before. The Eclipse Peat Company at Ashcott handle this fuel and also certain by-products.

By-Products. These are, chiefly, peat moss soil, which is used for gardening purposes and is found in the top five feet below the surface; peat moss litter, also found in this upper portion, which is of great value for cattle and horse bedding and which sells in compressed bales f. o. r. Ashcott at 45/- per ton (about $10.95 at normal exchange.)

Moss litter, in addition to being used for bedding, is easily turned in a high class manure after use in the stable and is also ground up at the local mills into peat dust. Peat dust is of use for poultry and fattener for other domestic animals; it is used as an absorbent and deodorant in packing meats and fish and also in horticulture generally. The peat

dust is sold at the Ashcott mills in compressed bales f. o. r. at 52-6 per ton ($12.78 at normal exchange.) The machinery used for pressing is of the latest type and has been installed only recently. It includes a steel structure with 50 tons pressure and is the only one of its kind in the country.

Manufactures. The peat found in this particular area contains an analysis of only 4.03 per cent ash and a more recent analysis gives 1.83 per cent. This compares favorably with the average ash content (3.27 per cent) of 57 samples taken from different parts of the world and with 5.62 per cent, the average of seven Canadian bogs. No sulphur is present in peat and the fumes during burning have an aroma that is pleasant rather than otherwise.

Inasmuch as the analysis of any given coal is readily obtainable, and inamuch as the analysis of this peat is known, it follows that by blending one or more coals with peat, a compressed fuel better than coal for certain purposes, can easily be manufactured. The Eclipse Fuel Co. Ltd. of Highbridge Somerset, is allied to the company above named and it undertakes, using the principle just mentioned, to manufacture a fuel to practically any analysis required. The name given to this manufactured article is Peatoids. They are not unlike a hen's egg in shape, being about 2½ inches long and 1¾ inches wide. Considerable time and thought were expended upon obtaining a shape such that, in whatever way they might be placed or thrown upon the fire, these peatoids would fall naturally into the best position for burning, practically stoking themselves and allowing plenty of air space around each. It is claimed that this fuel is clean, dustless and may be stored out of doors; it may be used in household grates or kitchen stoves or for steam-raising purposes, containing coal only. It is claimed that this is the first successful manner in which peat and coal have been combined and it is claimed, further, that the resulting fuel is cleaner, healthier and cheaper than coal.

Chemical Derivatives. The deeper the layer of peat, the blacker it is and these deeper strata of peat have many chemical possibilities. Gas for heating and lighting can be obtained therefrom; powerful disinfectant vegetable oils are obtainable. Soaps, face creams and other toilet preparations,

ink, and a motor fuel can all be made with derivatives from peat and recently a color, heretofore obtainable only in Germany, has been successfully extracted from it.

Experiments have resulted in the extraction of what is known as Peat Oil and this has been successfully used in the manufacture of a salve for mosquito bites, burns and the like. The oil is antiseptic and curative and possesses properties in the highest degree valuable in the treatment of skin diseases. It consists of a complex mixture of hydrocarbons, of oily and wax-like substances, for the most part paraffins, together with a proportion of creosote and the constituents of creosote, guiacole, etc. and also a proportion of complex bodies of the Phenolic group phenoloids. The phenoloids, which are disseminated throughout the whole of the higher bodies of the solid portion, are powerfully antiseptic, while the solid wax-like bodies have remarkable emollient properties.

In addition to this Peat Oil, which is obtained during retorting of black peat, the following by-products are obtained:

Tar (from which peat oil is distilled), Coke, Gas, Sulphate of Ammonia, Methyl Alcohol, Acetic Acid, Creosote, Asphalt, Paraffin.

German chemists who had been studying the peat question for many years conducted a number of experiments at these peat works and many of them were on a large scale. Their retorting of black peat resulted in the information and particulars now in possession of the owners of the works and which, incidentally, are today being put to practical use in Germany on a commercial basis. Experiments for the extraction of a spirit from light peat were carried out at these works and resulted in the production of over six gallons of spirit from one ton of wet peat dug straight from the bog; this spirit might be used as motor fuel, having been thoroughly tested for this purpose and for industrial purposes. The work was held in abeyance through the war but is now being opened up again by the present owners of the works.

In many of the other uses stated, peat has been supplied direct to manufacturers, who have used it for the pur-

poses stated and, in still other cases, there is ample proof and knowledge to verify the preceding statements.

The possibilities of these two new forms of the very old original industry are consequently very great and their further development is and will be of interest.

ABSTRACTS OF PATENTS.

Peat Product.

By Fred T. Dow.

This invention relates to a novel peat product.

As a result of some experiments I have been making with peat, I have discovered that if peat which has been macerated and reduced to a pulpy constituency is then further treated so as to form it into what I call pencil or stick-like fragments, that is, into elongated fragments which are not greater in diameter than one-quarter of an inch, it is then in such condition that it can be readily and rapidly dried, and when dried can be easily formed into briquets of desired size, simply by subjecting it to heat and pressure.

My invention, therefore, covers peat when reduced to this pencil-like or stick-like fragmentary condition.

An apparatus capable of producing peat having the above characteristics comprises a member in the form of a perforated plate or screen having small apertures therethrough of the diameter desired for the stick-like fragments and means for rubbing and forcing the peat through said apertures. As the peat is thus forced through these small apertures, it emerges therefrom in small tentaculiferous streams. These separate streams of peat break into short lengths as they emerge from the screen-like member so that the final form which the peat assumes is that of small fragments having the diameter of the holes in the screen-like member and varying lengths. The operation of rubbing the peat through these apertures compresses and condenses the peat so that the peat comprising each small stick-like fragment is compressed compactly together. Moreover, as the separate streams issue from the apertures in the sieve and break off at different lengths they are apt to curl slightly so that the final fragments are not necessarily straight but some of them may be curved in the direction of their length. These stick-like fragments will retain their shape, can be readily handled, and because of their general curved shape they form when collected together a more or less porous bulk through which a drying medium may be readily forced. Peat, therefore,

which has been reduced to pencil or stick-like fragments of this type can be readily dried because when placed on screens in bulk the drying medium is easily forced through the bulk because of the porous character thereof. Moreover, such peat when dried can be easily briqueted by subjecting it to heat and pressure, as above stated.

There is a screen or perforated plate having a plurality of small apertures therethrough. While the size of these apertures is not essential to the invention, yet I find best results are secured when the apertures are about an eighth of an inch to a quarter of an inch in diameter. If peat in a macerated, pulpy condition is forced or rubbed through these apertures it will emerge from the plate in small streams or jets and because of the pressure necessary to force the peat through these apertures, the peat in each stream will be firmly compacted together. As the streams emerge from the apertures they will break off at different lengths to form the stick-like fragments, and a considerable proportion of such fragments will curl more or less as they break, so that the resulting mass of stick-like fragments is a more or less porous mass.

Various devices may be employed for forcing or rubbing the peat through the apertures. One practical device comprises members in the form of rubbing knives which are arranged to be moved over the upper surfaces of the screen plate, said knives being constructed so that in their movement in one direction they will cut the peat and in their movement in the other direction they act as rubbers to rub the peat through the apertures. These rubbing knives are shown, each knife being in the form of a curved spring blade having a cutting edge which engages the upper surface of the screen member. The knife is so shaped that the under face thereof forms a rubbing face. When each knife is moving forwardly, the cutting edge thereof serves to cut the peat, and when it is moving in the opposite direction the rubbing surface has a rubbing action which forces the peat through the apertures. I have shown these knives as secured to a reciprocating carrier and as arranged in pairs, the knives of each pair being oppositely directed so that upon movement of the carrier in each direction part of the knives will be cutting

the peat and the remainder of the knives will be rubbing the peat through the perforations.

The screen plate is shown as forming the bottom of a trough in which the carrier and knives are received, and this trough communicates with a hopper or chambers into which peat may be fed by any suitable means. This hopper or chamber is provided with means for cutting or macerating the peat, such means being herein shown as a plurality of grate bars extending transversely of the hopper, and a plurality of cutting knives which are mounted on a shaft and which co-operate with the bars to cut and macerate the peat. The carrier is of a less width than the trough and the knives will preferably be formed with the wide cutting edge and rubbing surface which extends substantially across the trough, and with the narrow shank portion which is secured to the carrier. With this construction the carrier and knives do not interfere with the feeding of the peat to the screen member.

For feeding the peat to the hopper I have shown a plurality of feeding cylinders leading to the hopper, and each provided with a feed plunger for forcing the peat through said cylinder into the hopper. Each cylinder is formed at its lower end with a pivoted gate which opens downwardly automatically as the peat is forced therethrough, but which will close to prevent the peat from being forced upwardly through the cylinder. The plungers will preferably be operated successsively so that while one plunger is moving downwardly to force peat through its cylinder into the hopper the other plunger will be moving upwardly. The pivoted gates prevent the peat from being forced upwardly through the cylinder in which the plunger is retracting and thus compel the peat to be forced downwardly through the grates into the hopper.

The carrier may be reciprocated in any suitable way. I have herein shown for this purpose a shaft having a crank arm which is connected by a link to one end of the carrier that projects through the end of the trough.

The peat product which is formed by means of this invention has the advantage that it might be very quickly dried. The peat is formed into the stick-like fragments while

it is still moist, and when thus formed it can be dried completely in a very short time merely by introducing it into a drying oven. This is because of the fact that the individual fragments have a relatively small diameter and can be easily heated clear through and because of the further fact that a mass of these stick-like fragments is very porous so that when it is placed in a drying chamber the drying medium can readily penetrate through the mass. This is a decided advantage because in the manufacture of peat the operation of drying the peat is usually one that takes considerable time.

With my invention, however, the time required for this step is reduced to a minimum.

Moreover I have found that a peat product having the characteristics above pointed out can be easily formed into briquets by pressure and heat and since the drying is done before the briqueting process, the latter can be accomplished in a relatively short time.

While I have illustrated herein one apparatus adapted to produce my improved peat product, I wish to state that this is shown merely for illustration purposes and not with the intention of limiting the invention.

I claim:

1. A peat product in the form of stick-like fragments of closely compacted peat, each having a very small transverse dimension which is substantially uniform from one end of the fragment to the other.

2. A peat product in the form of stick-like fragments of closely-compacted peat, each fragment having a diameter considerably less than half an inch and some at least of the fragments being curved in the direction of their length.

3. A peat product in the form of elongated fragments of closely-compacted peat, each having a diameter of less than a quarter of an inch.

4. A peat product in the form in individual stick-like fragments of closely-compacted peat, each fragment having a substantially uniform cross-sectional dimension from one end to the other which is considerably less than half an inch. —U. S. Patent 1,444,344.

Briquet Machine.

By Swan E. Moren.

This invention relates to briquet machines and has special reference to machines of the type shown in Letters Patent No. 1,306,309, granted to me June 10, 1919, the object of the present improvements being to increase the efficiency of the apparatus and simplify the construction and operation.

There is shown a supporting frame which may be of any substantial construction, and consists of a plurality of posts upon which are secured beams in parallel relation. Supported upon the beams and extending between the same are a series of bodies in each of which a compressing mechanism is mounted and in rear of the several bodies a driving shaft extends longitudinally of the frame and is connected through gears with a crank shaft operatively connected with the working members of each compressing mechanism. Above the several bodies, a trough extends longitudinally of the frame and in the bottom of this trough is a conveyor by which the material is fed to a series of spouts and delivered through said spouts to hoppers on the respective bodies, as shown and as will be readily understood. The return run of the conveyor is disposed below the several bodies and between the said return run and the discharge openings of the bodies is a conveyer for carrying off the formed bricks. These conveyers may be of any preferred or convenient construction and will, of course, be operated by any preferred mechanism.

Each body comprises side rails connected at their forward ends by an abutment and at their rear ends by a pillar which is of less height than the abutment, the side bars immediately adjacent the pillar supporting bearings in which the main driving shaft is journaled. Secured to the abutment in any convenient manner is a stationary cylinder having longitudinal slots in its sides at its front end, the rear end of the cylinder having its wall beveled, for a purpose which will presently appear, and adjacent the rear end of the cylinder form within the circular wall of the cylinder a steam space which may be supplied with steam in any convenient manner, but is shown as communicating through a hose with the

steam jacket of the movable cylinder, a drain cock being provided so that the water of condensation in the jacket may be withdrawn when necessary. Within the cylinder is closely but slidably fitted a jaw having its rear end concave so as to receive and shape the material from which the brick is to be formed at the front end of this jaw I provide the laterally extending diametrically opposite lugs which are adapted to play in the slots of the cylinder, as will be readily understood.

The reciprocatory cylinder carries the hopper, and the wall of said cylinder and of said hopper is hollow and forms a part of the steam jacket to which steam is admitted through a supply pipe or hose. At the rear end of the cylinder are diametrically opposite guide lugs which rest upon the upper walls of the recesses formed in the side rails of the respective bodies and are held to said bases by cap plates secured upon the side rails in an obvious manner. The front extremity of the cylinder is beveled, reversely to the bevel of the stationary cylinder so that when the cylinders are brought together a close joint will be formed, leakage of material will be prevented, and all the material fed into the cylinder through the hopper will be compressed and a briquet of the desired size and weight will be produced. To reciprocate the cylinder, a rack is formed on the under side thereof and this rack is engaged by a segmental gear on the upper end of an oscillatory arm, which is pivotally suspended from the side members of the body. The lower end of the oscillatory arm or bar is connected by a link with the lower end of a lever which is fulcrumed upon the body and has its upper end carried rearwardly to be actuated by a tappet on the crank shaft so that the cylinder will be periodically withdrawn from the stationary cylinder. A spring attached to the frame and the lower end of the lever holds the parts normally in such position that the two cylinders will be in engagement.

Upon the sides of the cylinder, adjacent the end thereof, I provide the lugs having trunnions projecting therefrom and to the lugs I pivotally attach the rear ends of links which extend rearwardly therefrom and are provided with longitudinal slots in their rear ends. The said slots receive the

trunnions and thereby constitute a lost-motion connection between the two cylinders. It will be readily understood that during compression the two cylinders are in contact and the block is at the front end of the cylinder, the trunnions being at the front ends of the respective slots. When the cylinder moves rearwardly, the trunnions will ride in the slots until they reach the front ends of the slots whereupon the continued movement of the cylinder will draw the links rearwardly and thereby pull the said block rearwardly so that it will eject the briquet and upon the return movement of the cylinder the ejector block will remain in its rearward position until the trunnions engage the front ends of the slots whereupon the ejector block will be returned to its position against the abutment.

Within the cylinder is mounted a plunger or piston consisting of a front member having its front end recessed, to impart the desired form to the briquet and a rear member which is coupled to the front member in such manner that the said front member may yield to any large stone or other unyielding elements which may pass into the hopper with the compressible material. The plunger is reciprocated by a pitman engaged upon and actuated by a crank of the shaft.

In operation, the plunger is withdrawn so that material fed into the hopper may pass into the cylinder and thereby be held in front of the plunger. The rotation of the crank shaft will force the plunger forward in the cylinder and the material to be compressed will be thereby pushed against the receiving jaw ejector block and will be compressed, the parts being so timed that as the plunger recedes the cylinder will also recede so that an open space will be produced between the two cylinders, and just before the movable cylinder reaches the rear limit of its movement the block will be drawn rearwardly so that the formed brick will be freed of the stationary cylinder and will drop through the opening between the two cylinders onto the conveyer. Immediately after the block has been thus ejected and discharged, the tappet will clear the end of the lever and the spring will return the cylinder to its forward position, whereupon another

charge may be delivered thereinto. The rearward movement of the plunger, of course, continues until the front end thereof has cleared the hopper so that there will be no obstruction to the delivery of the material into the cylinder and the return forward movement of the plunger will cut off any additional flow from the hopper.

In my present apparatus, the material which is being compressed is heated through its contact with the hot walls of the two cylinders and is, therefore, more plastic and may be compressed more readily and more firmly than when it is not exposed to the action of a heating agent. Also by my present construction I provide an abutment having a continuous uninterrupted face so that a better finish in the product is attained and the ejecting of the formed brick is more positively effected than by the arrangements heretofore employed. The links constituting the lost motion connection between reciprocatory cylinder and the abutment jaw or ejector block are arranged between the cylinders and the side rails of the respective bodies so that they are protected from injury by chance blows and are in operative condition at all times. The present construction is not costly and adds to the efficiency and durability of the apparatus.

Having thus described the invention, what is claimed as new is:

1. In a briquet machine, the combination of a stationary cylinder, a reciprocatory cylinder arranged to abut and form a close joint with the stationary cylinder, a combined compressing jaw and ejector block mounted in the stationary cylinder, a plunger slidably mounted in the reciprocatory cylinder, means for reciprocating the plunger and the said cylinder, and means for heating the walls of the two cylinders.

2. In a briquet machine, the combination of a stationary cylinder having a hollow wall, a compressing jaw fitted in said cylinder, a reciprocatory cylinder arranged to abut the stationary cylinder and form a close joint therewith, a plunger mounted in the reciprocatory cylinder to cooperate with the said compressing jaw, a hopper mounted on the reciprocatory cylinder, and means for heating the walls of the two cylinders and the said hopper.

3. In a briquet machine, the combination of a stationary cylinder, a compressing jaw fitted therein, a jacket formed in the wall of the said cylinder, a hollow-walled reciprocating cylinder mounted to abut and form a close joint with the stationary cylinder, a hollow walled hopper on said reciprocatory cylinder, a flexible connection between the two cylinders establishing communication between the jackets of the same, and means for supplying a heating fluid to the jacket of one of the cylinders.

4. In a briquet machine, the combination of a stationary cylinder, a block fitted in said cylinder, a reciprocating cylinder mounted to abut the stationary cylinder and form a close joint therewith, a plunger fitted in the reciprocating cylinder, and a lost-motion connection between the reciprocating cylinder and the block in the stationary cylinder.

5. In a briquet machine, the combination of a stationary cylinder, a block fitted therein and constituting a combined jaw and ejector, guide lugs on said block extending through and guided by the wall of the stationary cylinder, a reciprocating cylinder arranged to abut and form a close joint with the stationary cylinder, a plunger mounted in the reciprocating cylinder to cooperate with the said block, trunnions on the reciprocating cylinder, and links pivoted to the guide lugs on the said block and having longitudinal slots engaging the said trunnions.

6. In a briquet machine, the combination of a stationary cylinder having an open rear end and having its wall beveled around said end, a block fitted within said cylinder, a reciprocating cylinder having its end beveled to fit to the beveled wall of the stationary cylinder and form a close joint therewith, a plunger mounted in the reciprocating cylinder, and means whereby when the reciprocating cylinder recedes from the stationary cylinder the block in the latter cylinder will be actuated to eject a brick formed therein.—U. S. Patent 1,384,200.

Means of Obtaining Carbon From Peat.

By John E. Leadbetter.

Claim—1. The process of treating peat for obtaining a decolorizing carbon by first drying and finely dividing the peat to be treated, then mixing it with finely divided caustic lime (unslacked or quick lime) to disintegrate the peat, and placing the dry mixed materials in trays and heating them in an oven to a required temperature for reducing the peat to a granular form and afterwards washing and teating the residual carbon with a dilute acid, such as hydrochloric acid, for the removal of foreign substances, then mixing with the washed material Fuller's earth, and finally heating the mixed materials a second time in an ovén, as and for the purposes set forth.

2. The employment for decolorizing purposes of a carbon obtained from the treatment of peat by the process of first drying and grinding the peat, then mixing it with caustic (unslacked lime) to disintegrate the peat, placing the dried mixed material in trays and heating the materials in a retort to the required temperature for reducing the peat to a granular form, and afterwards washing and treating the residual carbon with an acid as described for the removal of foreign substances and impurities before again being placed in the tray and a second time heated and dried in the retort, as set forth.

Claims allowed, 2.—Canadian Patent 215,796.

Peat Drying Process.

By E. P. Reinholdowitsch.

Claim—1. A process of treating peat mass in the manufacture of peat briquettes, characterized in that the peat-mass is thoroughly disintegrated and mixed with water to form a homogeneous peat-porridge in a rotary or turbine pump which also produces the pressure necessary to force the homogeneous peat-porridge through a pipe line directly to the drying place where it is spread out in a thin layer and allowed to dry being thereafter cut up into briquettes by suitable means.

2. As a step in the process claimed in claim 1, conveying the homogeneous peat-porridge to the drying place by

means of a pipe line composed of a plurality of detachable sections, the sections being removed as the discharge advances over one area of the drying place and rejoined together on the next adjacent area of the drying place ready to be used subsequently in covering the same, substantially as described.

3. A rotary or turbine pump for use in carrying out the method claimed in claim 1, characterized by co-acting stationary and revoluble cutters provided at the lower end of the pump casing for the purpose of cutting up large bodies in the peat mass as it enters the pump casing, substantially as described.

Claims allowed, 5.—Canadian Patent 216,425.

Distillation of Peat.

By A. J. Robus.

In apparatus for the distillation of peat, the raw peat is charged into a hopper and fed by rotary spiral conveyers through tubular retorts maintained at a temperature of about 500 degrees C. at the hot zone by burning the non-condensible gases generated in the apparatus. The conveyers extend only along the cooler parts of the retorts in which the raw peat, due to compression, is caused to give up its moisture as water which is drained off at the charging end. Oil and tar vapor are collected in the upper part of a chamber and led by a pipe to condensers, and the charcoal falls to the bottom of the chamber and is removed therefrom to adjacent cooling chambers, in which it is quenched.—British Patent 173,662.

Excavating Peat.

By G. O. Strenge.

In a peat-excavating machine, the excavating device is transeverely movable on a cross beam which is pivoted on a truck and is connected at its ends by ropes to a winch, by which its inclination may be adjusted. A counterweight balances the excavating device, which comprises three or more chains carrying shovels; the shovels have no back and each comprises a plate, with curved rear edge and a number of cross partitions corresponding to the number of chains, one partition being connected to each chain. The excavating device delivers to a peat moulding machine carried by the truck and

the counterweight may be replaced by a suspended peat-conveying device arranged in proximity to the moulding machine. Behind the truck is fixed a device for removing the top layer of earth from the peat.—British Patent 173,884.

Peat.

By H. A. Mueller.

The percentage of carbon in peat is increased, otherwise than by coking, by treatment in closed vessels with bacteria and fungi of the kind used in clarifying sewage. Preferably the quantity of water present, which may be used repeatedly for further quantities of peat, is such that solid particles amount to two per cent of the mass, which should be neutralized before treatment if it contains a considerable amount of humic acids. Salts of phosphoric acid, potash, and magnesia, etc., required in the growth of the bacteria are added if the peat is deficient in such substances. The process may be accelerated by introducing some peat already under the action of and rich in bacteria and fungi. The escaping gases, chiefly hydrogen, methane, and carbon dioxide, may be utilized for generating the heat or power.—British Patent 175,978.

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AMERICAN PEAT SOCIETY.

SCOPE AND PURPOSE.

The American Peat Society was organized at the national exposition at Jamestown, Va., on October 23, 1907, and was incorporated in 1912. Its purpose is to disseminate information concerning the origin, metamorphosis, geographic distribution, physical and chemical properties, and uses of peat, muck, and humus, and to stimulate interest in the commercial utilization of the widely-distributed, valuable deposits of these substances in North America.

NATURE AND USES OF PEAT.

Peat is the organic residuum resulting from the arrested decomposition of leaves, twigs, roots, trunks of trees, shrubs, mosses, and other vegetation in areas continually covered or saturated with water. It may be identified as the dark-colored soil found in bogs and swamps, commonly called muck. The commercial uses of peat are numerous and varied. In the countries of northern Europe it is used for fuel and as the basis for many manufacturing industries. Gas, substitutes for petroleum products, charcoal, coke, and a number of valuable by-products are produced in small quantities from it. Peat moss, marsh grass, and fibrous peat are employed in the manufacture of surgical dressings, of rugs and carpets, of packing material, of artificial wood, of paper, and of substitutes for cotton and woolen cloth. In the United States peat is utilized chiefly as an ingredient of fertilizers and stock food and as a crop soil.

ECONOMIC ASPECTS OF PEAT.

The United States contains about 12,000 square miles of undrained land estimated to be capable of yielding nearly 14 billion short tons of air-dried peat. The average deposit will yield 200 tons per acre foot. The peat areas are distributed throughout the Great Lake, New England, and Atlantic and Pacific Coast States. The peat deposits of Canada cover 37,000 square miles. The annual value of the products made from peat in the United States amounts to about $1,000,000. The proceeds received from the cultivation of peat and muck land are far in excess of this figure. European countries annually consume more than 50 million tons.

MEMBERSHIP.

The present membership of the American Peat Society consists largely of agriculturists and peat producers. Persons interested in agriculture, in soil fertilization, in the chemical and bacteriological aspects of vegetal mat-

ter, and in the production of fuel or generation of power are urged to join. Enrollment will be found as valuable by them as it is to the owners and operators of peat and muck areas, who consider their connection with the society a decided business asset. Applications should be addressed to the secretary. Membership and subscription to the journal cost $5.00 a year.

CONVENTIONS AND PUBLICATIONS.

The meetings of the society are held annually in important cities throughout the peat regions. Many original papers relating to the subjects enumerated are presented every year. A quarterly journal containing the proceedings of the society, news of the industry and contemporary literature concerning all phases of the peat and allied industries is published and sent to members. This journal is unique among the scientific publications of the United States, as it is the only one that treats all branches of the peat industry. Its success in stimulating interest in the possibilities of peat, in pointing out the location of deposits, in explaining production methods, in exposing the incompetent engineering practice that has caused many failures, and in stamping out false promotion, has been the subject of favorable comment throughout the world.

General inquiries relating to the objects of the society will be answered free of charge by the secretary or editor, but it should be understood that detailed information will not be so given. Such advice can be obtained from experts whose names will be furnished upon application.

APPLICATION FOR MEMBERSHIP
IN THE
American Peat Society.

(Date)

MR. CHARLES KNAP, *Secretary-Treasurer,*
American Peat Society,
2 Rector St.,
New York, N. Y.

Dear Mr. Knap:

Application is hereby made for membership in the American Peat Society. Check in the sum of $5.00 for subscription to the Journal of the American Peat Society during the first year is inclosed. It is understood that the payment of this sum will admit me to the society and entitle me to all the privileges granted to members by the constitution. This action is prompted by my interest in the utilization of peat and the welfare of the society.

Yours very truly,

(Signature)

(Address)

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The publication of articles in this journal should not be considered an endorsement of them by the society or its officers. Manuscripts sent for consideration by the editor should be registered. Written discussions of papers are invited. Authors wishing reprints of articles are requested to correspond with the editor. Advertising rates will be furnished upon application to the secretary.

Press of
TOLEDO TYPE-SETTING & PRINTING CO
Toledo, Ohio.

Journal of the
American Peat Society

VOL. XV. OCTOBER, 1922. NO. 4.

PROCEEDINGS OF THE SIXTEENTH ANNUAL CONVENTION.

The Sixteenth Annual Convention of this society which was held at South Bend, Indiana, August 29, 30 and 31, was from every viewpoint one of the most successful meetings held by the organization in recent years. The daily attendance ranged from 50 to 100 and a feeling of good fellowship prevailed throughout the proceedings. Representatives were present from Canada and from practically every state where peat deposits are located. Careful preparations had been made by Messrs. J. H. Beattie, of the Bureau of Plant Industry, E. C. Bird, County Agricultural Agent, Frank J. Green, Secretary of the Chamber of Commerce, and others, and each day had a full quota of profitable entertainment. The meetings were held in the Chamber of Commerce rooms. A brief abstract of the proceedings follows:

TUESDAY MORNING, 9:00-12:00

President Myron W. Robinson, Chairman

Registration of members and visitors at Chamber of Commerce Auditorium 9:00-10:00
Greetings ..... Mayor Siebert of South Bend
President's Address ..... Myron W. Robinson
Communications ..... Myron W. Robinson
Appointment of Committees on Nominations and Resolutions ..... Myron W. Robinson

Administrative Phases of Peat Utilization.....John N. Hoff
(President Alphano Humus Company and Chairman Executive Committee).

Factors Underlying the Settlement of Peat Land....Ezra Levin
(Michigan Department of Agriculture)

Luncheon at 12:30.....Dining Room Hotel Oliver

An interesting exhibit of truck crops produced under the direction of Professor J. H. Beattie of the Bureau of Plant

Members of the society who visited the Studebaker plant.

Industry on experimental muck plots owned by W. C. Steenburg near South Bend was examined by members during the morning proceedings.

TUESDAY AFTERNOON 2:00-3:30

Fertilizer Experiments with Celery, Lettuce, and Onions on Muck Soils at Williamson, New York
Professor J. H. Beattie
Bureau of Plant Industry, United States Department of Agriculture)

Use of Muck Soils for Production of General Farm Crops ..... Professor S. D. Conner
(Associate Chemist in Soils and Crops, Indiana Agricultural Experiment Station)

Peat Soils in Vegetable Production....Professor W. R. Beattie
(Extension Horticulturist, Bureau of Plant Industry, Department of Agriculture)

An interesting discussion followed each paper.

At 3:30 o'clock the meeting was adjourned and members enjoyed a trip through the Oliver Plow Works, where they were shown every step in the manufacture of agricultural implements in the shops as well as by moving pictures. At the close of the trip an inspection was made of a plow developed by the Oliver Works for use on peat and muck land.

The annual smoker at 8:00 o'clock p. m. was an especially enjoyable affair and many varied and interesting experiences were discussed. Better acquaintance that will tend to further the interests of the society was stimulated.

WEDNESDAY MORNING 10:00-12:00

Wednesday morning was spent at the plant of the Studebaker corporation. This plant is said to be manufacturing a larger number of automobiles daily than any except the Ford Motor Co. All the processes by which automobiles are made on a large scale were shown in detail to the delegates. Films of some of the principal processes were exhibited at the close of the trip through the factory, and dinner was served in the Administration Building. The accompanying pho-

tograph of the delegates was taken at the front entrance of this building.

WEDNESDAY AFTERNOON 2:00-5:30

The following report, prepared by Charles Knap, Secretary-Treasurer, was submitted and unanimously approved:

FINANCIAL STATEMENT FOR YEAR ENDING JUNE 30, 1922

Receipts.

Subscriptions from members	$ 855.19	
Journals sold	147.40	
Advertisements	118.10	
	$1120.69	
Cash on hand July 1, 1921	$ 194.52	

Disbursements.

Printing and mailing Journals:		
Account January, 1921, Journal		$ 100.00
Balance July and October, '21, Journal		403.59
Account January, 1921, Journal		78.76
Balance January, 1921, Journal		100.00
Printing, January, 1922, Journal		143.96
Index		25.50
Envelopes		9.00
		$860.81
Editor's expenses		148.65
Annual meeting 1921		44.98
Mimeographing		7.95
Clippings		26.20
Stationery		28.05
Postage		32.82
Typewriting		5.00
Refund over-subscription		5.50
Bank collection charges		5.95
Exchange		1.67
Cash on hand June 30, 1922		147.63
	$1315.21	$1315.21

Bills Receivable.

Balance due for advertisements in Journal	$8.60	
Unpaid subscriptions	180.00	
Back Numbers Journal sold	5.00	
Cash on hand July 1, 1922	$147.63	
		$341.23

Bills Payable.

2nd quarter payment due June 1 to Editor under arrangement whereby he defrays cost of publishing Journals, Paid by Trade Acceptance due November 8, 1922	$ 300.00
Surplus	41.23
	$ 341.23

Mr. C. C. Osbon, chairman of the committee on increased membership and editor of the Journal, submitted a report showing the results of his campaign for increased membership. Each officer and member of the Executive Committee had been asked to submit 10 memberships or $50 and the peat regions were divided into 14 districts and a sub-chairman appointed for each district, with the request that he submit 5 memberships or $25. The following results were obtained during the first half of the year:

Name	No. of Subscriptions
Robert Ranson, St. Augustine, Fla.	4
E. V. Moore, Montreal, Canada	1
Fred Wiedmer, St. Louis, Mo.	5
Myron W. Robinson, New York, N. Y.	2
Charles Knap, New York, N. Y.	5
Editor's Office	9
F. A. Wildes, Hibbing, Minn.	1
Harry Wolf, New York, N. Y.	1
F. E. Dellenbaugh, Cleveland, Ohio	1
J. H. Beattie, Washington, D. C.	1
	30

During 1921 Myron W. Robinson, President, obtained sev-

enty new members, and during the six months ended December 31, 1921, Mr. Knap obtained twenty new members. During the first six months of 1922 the secretary's office sold back numbers of Journals to the amount of $81.30, and the editor's office $66.10. There were no alternative contributions. The following statement showing the status of membership on June 30, 1922, was presented:

Enrolled during year (June 30, 1921-June 30, 1922)	51	51
Resigned during year (June 30, 1921-June 30, 1922)	30	
Dropped for non-payment of dues (June 30, 1921 June 30, 1922)	17	
	47	47
Net gain		4
Total active members June 30, 1922	182	
Total honorary members June 30, 1922	7	
Total exchange members June 30, 1922	31	
Total free members June 30, 1922	18	
	238	

In closing Mr. Osbon announced that the campaign would be continued during the year 1922. The objects and accomplishments of the society were outlined, all non-members present were invited to join, and members were exhorted to make an energetic attempt to fill their quotas during the remainder of the year.

The report of the Committee on Nominations, consisting of A. W. Perelstrous, W. C. Steenburg, and J. H. Beattie, was then received. All persons nominated by them were unanimously elected. The officers elected the previous year were reelected, except C. S. Robinson, First Vice President, who resigned, and whose place was filled by Fred Wiedmer, President of the Wiedmer Chemical Company, St. Louis, Mo., and except Herbert Phillip, a member of the Executive Committee, who was succeeded by George H. Payne, of Omaha, Neb.

THURSDAY MORNING 10:00-12:00

Production of Mint on Muck Soils.....Professor G. A. Russell
(Bureau of Plant Industry, Department of Agriculture)
Peat as a Fertilizer Ingredient.....John Wiedmer
(President Wiedmer Chemical Company)
Replacement Fertilization of Peat Lands.....Prof. F. J. Alway
(Division of Soils, University of Minnesota)
Peat Fuel Resources of the United States.....C. C. Osbon
(Formerly in Charge of Peat Investigations for U. S. Geological Survey)
Peat Deposits of Indiana.....W. N. Logan
(State Geologist of Indiana)
Recent Work of the U. S. Bureau of Mines on Peat and Lignite .....R. H. Kudlich
(Assistant to the Chief Mechanical Engineer, U. S. Bureau of Mines.)
Can Peat be Manufactured Commercially?.....E. V. Moore
(Fuel Engineer in Charge Experimental Plant of Canada Department of Mines.)

A demonstration was made of the use of peat as fuel at the close of the Wednesday afternoon session.

Invitations from the governor and other officials and organizations of Florida, and from civic organizations of Philadelphia, to hold the convention for 1923 in Florida and in Philadelphia, were received and a resolution of thanks was unanimously approved. The invitations were referred to the Executive Committee for consideration at the appropriate time.

The editor announced that all papers presented at the convention would be published in succeeding numbers of the Journal at the earliest opportunity.

An invitation was received from the South Bend Tribune, and accepted with thanks, to visit the building and plant of that organization at the close of the convention.

Mr. J. H. Beattie offered a motion providing for the appointment by the editor of several assistant regional editors. The motion was seconded and passed, and the editor announced that after communicating with the proper persons, he would publish the names in an early number of the Journal.

The committee on resolutions, consisting of George F. Johnson, R. A. Strecher and Paul M. Harmer, moved that a vote of thanks be tendered to the city of South Bend, the Mayor, Chamber of Commerce, County Agricultural Agent, local newspapers, Studebaker Corporation, Oliver Plow Works, and many others whose efforts and courtesy made possible the profit and pleasure which members of the society enjoyed during the convention. It was the consensus of opinion that the society had never been received and treated more graciously by any city. There being no further business, the convention adjourned sine die.

On Thursday afternoon, an inspection was made of the peat and muck experimental lands of the Bureau of Plant Industry, U. S. Department of Agriculture, on the Steenburg tract, South Bend. Professor J. H. Beattie of the Department of Agriculture, who directed the work, explained to members the fertilizer and cultural treatments received by the various plants and pointed out the results obtained.

The following is an incomplete list showing some of those who attended the convention, and their occupations:

B. F. Haanel,
Chief Engineer,
Department of Mines,
Ottawa, Ontario, Canada.

Willis Kinyon,
Florist and Landscape Architect.
1237 Kinyon St.,
South Bend, Indiana.

Frank E. Martins,
Editor Potato Magazine
Niles, Michigan.

W. C. Harder
Farmer
North Liberty, Ind.

Mrs. R. Schiber,
Real Estate Dealer
Seattle, Washington,

E. C. Bird,
County Agricultural Agent.
South Bend, Ind.

Robert H. Kuss,
Mechanical Engineer.
975 Old Colony Bldg.,
Chicago, Ill.

A. W. Perelstrous,
Natural Resources Development Company.
Drexel Bldg.,
Philadelphia, Pa.,

C. H. Garver,
Horticulturist.
Route 1, Box 72-C,
South Bend, Ind.

C. F. Brown,
Peat Business.
South Bend, Ind.

R. Kudlich,
Bureau of Mines,
Washington, D. C.

F. F. Stroub,
Real Estate Dealer.
Omaha, Nebraska,

R. A. Strecher,
Development Peat Land
Elkhart, Ind.

S. D. Conner,
Chemist.
Lafayette, Ind.,

W. Place,
Farmer.
322 S. Lafayette Blvd.,
South Bend, Ind.,

W. C. Steenburg,
Farming.
228 S. Main St.,
South Bend, Ind.,

W. G. Newbury,
5816 West End Ave.,
Chicago, Ill.,

Ezra Levin,
State Department of Agriculture.
Lansing, Mich.,

C. C. Osbon,
Economic Engineer.
Ponca City, Okla.,

Paul M. Harmer,
Soils Department, Michigan Agricultural College.
East Lansing, Mich.

Geo. F. Johnson.
Assistant Editor, Indiana Farmers' Guide.
Huntington, Ind.

Myron W. Robinson,
Crex Carpet Co.
New York, N. Y.

W. W. Place,
Farmer.
Walkerton, Indiana,

I. R. Ferguson,
Farmer.
Buchanan, Michigan.

H. F. Goppert,
Farmer.
Walkerton, Ind.

H. R. Smalley,
National Fertilizer Association.
Chicago, Ill.

G. H. Payne,
Real Estate Dealer.
Omaha, Nebraska.

J. N. Hoff, Pres.
Alphano Humus Co.
New York, N. Y.

J. H. Beattie,
Horticulturist,
Department of Agriculture,
Washington, D. C.,

R. M. Snyder,
Experiment Station.
East Lansing, Mich.

Tobias Bradley,
Manito Humus Co.,
Lehman Bldg.,
South Bend, Ind.,

H. E. Wiedemann,
Chemist.
St. Louis, Mo.

Fred Wiedmer,
President Wiedmer Chemical Company.
St. Louis, Mo.

M. A. Garett,
Studebaker Corporation
Riverside, 1021,
South Bend, Ind.

S. O. Nafziger,
American Manufacturing and Engineering Co.
Goshen, Ind.

N. R. Rose,
Real Estate Dealer.
Chicago, Ill.

R. S. Lundin,
County Agent.
Rochester, Ind.,

E. S. Hanson
Editor Fertilizer Green Book.
Chicago, Ill.,

G. W. Blaine,
Farmer.
Walkerton, Ind.

W. H. Kirst,
Darling & Company,
4201 S. Ashland Ave.,
Chicago, Ill.

C. W. Blocker,
Field Assistant, U. S. Dept. of Agriculture.
Route 1, Box 72,
South Bend, Ind.

L. H. Erler,
Manito Chemical Co.
Peoria, Ill.

PEPPERMINT ON MUCK SOIL.[1]

By G. A. Russell, Bureau of Plant Industry.

Introduction

The cultivation of peppermint was introduced into the United States by way of early settled New England. Wayne county, New York, was the first locality in which it was grown and distilled as a commercial crop. Here the industry has flourished from 1816 until today, however with a gradual diminution in the acreage until at present the amount of peppermint grown in New York State is of relatively small importance when compared to the total domestic production. Gradually the industry moved westward, and 1836 the cultivation of peppermint was begun on White Pigeon prairie in St. Joseph County, Michigan. This venture was not a success financially, and was abandoned. In 1842, however, the industry was started again in the township of Florence, and from then on it was developed into one of the routine farm crops. About the year 1875 mint growing on muck came into vogue and today one rarely finds mint grown on upland in Indiana or Michigan. Within very recent years the cultivation of peppermint has developed in the State of Oregon where several thousand

[1] Read at the Sixteenth Annual Convention of the American Peat Society at South Bend, Ind.

pounds of oil are produced annually. This oil is not distilled from mint grown on muck soil, but from that grown on low land, the so-called "lake bottom land."

Cultivation

The cultivation on muck soil has proven to be very successful. Its present high state of development has not however been obtained without the usual hard work and experimentation. The best methods in use now have come only through faithful endeavor, and the desire to constantly improve on methods of the past. Today the industry has reached a point in both methods of cultivation and in acreage where it appears that further development cannot be expected. It is believed that this condition is apparent only and we may confidently look for improvement in cultural methods and for somewhat increased acreage. New uses for the oil will be discovered, and the outlet at present enlarged to take care of the growing demand for the various articles into which peppermint oil enters as a necessary ingredient.

Muck soil to be planted in peppermint is best plowed in the fall. The following spring the soil should be thoroughly disced, preferably both ways, then harrowed and well dragged down. The final treatment before planting consists in packing the soil with a heavy roller. This treatment leaves the seed bed in excellent shape to receive the planting stock .

The roots and runners which constitute the planting stock are dropped in freshly made trenches which have been opened up by any convenient method suitable to the area under cultivation. These roots which may come from old plantings on muck or preferably from plants grown for the purpose on high land are distributed by hand in the trench and immediately covered with fresh soil. The planter carries a sack of roots over his shoulder and as he walks along drops the roots in the trench so as to form a practically continuous line. He also scrapes the soil into the trench over the roots with his foot One acre planted by this method is considered a day's work. After planting, the field is dragged over to level it off, and also

to finish covering the roots thoroughly. The rows of mint are spaced approximately 3 1-2 feet apart.

Within a few days after planting the field is cultivated with a spike tooth harrow or with a weeder no attempt being made to follow the rows but rather the cultivating is done in all directions. This treatment destroys the young weeds and keeps the surface of the soil well stirred. When the plants attain a size of about three to five inches the young mint is then cultivated in the row and this cultivation is kept up until the growth of the plants is such that "runners" begin to fill the space between the rows.

Hand weeding is necessary in addition to thorough cultivation. This weeding is especially desirable and necessary just before harvest for weeds not only interfere with the growth of plants but when distilled with the mint impart to the oil a disagreeable and undesirable odor and flavor. Many of the more common weeds found on muck soils contain volatile oils, and the careful grower always keeps his fields clean of weeds in order to insure a good quality of mint oil.

Peppermint should be harvested when the plants have just reached the stage where the flowers begin to open; in other words, in the late bud stage. This stage of growth varies with the locality and with the age of the plantation, mint two or three years old coming into bud earlier than one year plants. It is frequently cut with the scythe, especially when the crop is exceedingly heavy in the first year, but more often with a mower. The cut herb is allowed to lie in the swath for about one day, and is then raked with a side delivery rake and bunched with a fork to facilitate handling. It is then loaded on hayracks, and taken to the still where the oil is removed by distilling with live steam.

Fertilization

The muck soils of Indiana and Michigan are among the richest soils in these states. However, these rich soils are usually deficient in some one or more constituents that the plant needs in order to attain the maximum desirable growth and quality. The whole question of fertilization is one that re-

quires considerable study and this applies specifically to the fertilization of mint crops grown on muck soils. Without doubt a large fund of valuable information is locked up in the experience of the individual growers, this information having been often gained at considerable expense. There are no known means of gathering this information and making it of general public use. It is generally conceded, however, that the application of potash at the rate of 150 to 200 pounds per acre to the non-acid muck soil is of value not only in providing this necessary plant food, but also in preventing or modifying a form of chlorosis apparently favored by too much water in the soil.

Phosphorus in the form of acid phosphate is said to be beneficial when applied at the rate of 200 pounds per acre on non-acid muck soil.

Although the nitrogen contents of muck soil is usually high, many growers claim that an application of from 50 to 100 pounds of nitrate of soda per acre is often beneficial, especially when applied early in the season.

Such fertilizers as lime, and stable manure have met with little favor among the growers. The former, it is claimed, is not needed on non-acid muck and the latter induces a succulent growth of the mint plant and usually introduces a quantity of weed seeds which soon germinate and become pests, causing a decided increase in the cost of production of the mint herb, due to the excessive weeding. It is stated that stable manure applied to the fields one or two seasons in advance of the mint crop, exerts a favorable influence on its growth. The spent herb or steamed hay when returned to the fields, constitutes a good fertilizer as does also the second growth of the mint plants when the same is plowed under late in the fall. The usual cost per acre for fertilizer on an average peppermint farm is approximately 60 percent of that spent for fertilizing onions, and 27 percent of that expended for fertilizing celery. It is, however, about twice the amount expended in fertilizing grain and stock farms.

Excluding "drainage," the question of fertilizing muck soil is said to be the most important factor in determining crop

production on muck land. As far as is known, no systematic study of the fertilization of peppermint has ever been made. It is recognized, however, that this problem is of importance, and it is hoped that plans can be perfected this year to inaugurate a series of experiments dealing with the question of the proper fertilization of mints. The data thus secured would then be available within the next two or three years and it is believed would prove of value to every grower of mint in the producing district.

Diseases and Pests

Peppermint is unusually free from diseases and pests. In addition to the chlorotic condition mentioned, which is associated with excessive moisture, a rust fungus sometimes strips the foliage from the stems. This fungus usually appears only in local manifestations, and then only when the season has been particularly moist.

Such injury as may be occasioned by grasshoppers, crickets, and caterpillars, is always a contingency if these pests appear in any great numbers. Cut worms are troublesome at times, but they can be controlled with poison bait. Peppermint may be said to rank in certainty of production equal to, or even above, the other crops grown on muck soils.

Duration of a Plantation

The common practice at present among mint growers is to run a plantation an average of three seasons, and then deeply plow down the field and plant to another crop. This short life is due in all probability to several causes, chief of which is improper attention. Other causes being winter killing and the natural dying out of the plants. If a field is given the proper treatment, there appears to be no reason why its life could not be successsfully extended.

To carry a field of mint over winter, it should be plowed late in the fall. This treatment appears to benefit the old roots by practically transplanting them into fresh soil and at the same time it turns under the runners which in the spring send up new shoots. The following spring the field is packed with

a heavy roller. After packing, the ground should be gone over with the harrow just as it is on a field of new mint. In fact the cultivation may be so arranged that quite definite rows can be laid off when the mint is young, and the cultivator kept busy between these rows for the best part of the season. A small amount of the fertilizer, preferably potash, applied in the spring will in all probability help the crop. The weeding must be done with regularity, and the fields kept clean. This practice if kept up each year, and winter killing is not too severe, will enable the grower to carry his plantation over a considerable number of years with a good yield of herb each season. Plantations are said to exist in Indiana which have yielded a crop continuously for twelve years, and which at the end of that period were apparently in as thrifty a condition, and as productive as ever.

Yields and Returns

Two crops of mint are possible in most seasons. It is poor practice, however to harvest the second crop except in the year in which the field is to be turned over to another crop The second growth when turned under in the late fall is valuable as fertilizer. If the crop is harvested the roots of the plants are weakened and made more susceptible to winter killing. The yield of oil from the second crop is usually less than one half that from the first crop and all things considered, it is the best practice to turn under this second growth.

The yield of peppermint oil varies throughout a wide range, running from twenty to eighty pounds per acre, depending upon the seasonal variation, type of soil, the care the plantation has received, the type of mint grown, and the care exercised in distilling. An average yield of forty pounds of oil per acre over a period of years is taken as a very good crop return.

The steamed hay when dried has a value which must be taken into account. If returned to the fields as fertilizer, its value is not readily computed but when used as hay for feeding purposes, the value is easily obtained by comparison. Peppermint hay is said to have a feeding value about equal to that of timothy, and is relished by all kinds of stock.

In comparison with other muck land crops, peppermint occupies a good position. It can be fairly compared with intensive crops such as celery, onions and potatoes, but it cannot be compared in fairness with corn, oats, rye, wheat and hay. In Table I the comparison is made between these intensive crops as regards man and horse labor required per acre.

Table I.

Crop	Days of labor per acre	
	Man	Horse
Peppermint	8	4
Potatoes	9	7
Celery	37.5	18
Onions	32	4

The figures in Table I show only a comparison among themselves with respect to the various crops under consideration. However, if taken in consideration with the figures given in Table II, some reliable conclusions and comparisons can be drawn. The figures given in these tables are averages from a number of muck farms, and are for the year 1914, none being available for the later date. However, by substituting present day gross values in Table II, the gross value per day of man labor can be secured. If this substitution is made it must be borne in mind that it applies only to the individual case being considered unless an average substitution figure is employed.

Table II.

Crop	Gross value produced	
	Per acre	Per day of man labor
Peppermint	$64.70	$8.09
Potatoes	35.97	4.00
Celery	161.52	4.31
Onions	176.82	5.53

It will be noted from the figures in the above tables that peppermint requires less man and horse labor per acre than do the three other intensive crops mentioned, and that the

gross value produced per man is greater in growing peppermint than cultivating any of the other crops. The limited demand for peppermint oil militates against its extensive cultivation with the result that it is better policy to grow a diversified crop, including some peppermint, than it is to grow peppermint only. This is especially true on small farms and where capital is limited.

In all types of farming, there is an element of risk due mostly to fluctuations in prices and yearly variations in yield. This element of risk is high in intensive types such as peppermint farming. This is well recognized by all farmers, and mint farmers recognize that a high yield of oil throughout the muck section of northern Indiana, and southern Michigan means that a lower price will be received. Taken throughout a period of years, however, the mint farmer's income from his crops averages as high, if not higher, than most other intensively grown crops.

ADMINISTRATIVE PHASES OF PEAT UTILIZATION.[1]

By J. N. Hoff,
Alphano Humus Co.

The executive work in connection with peat utilization demands expert knowledge, practical experience and persistence. It must literally start "from the ground up" as proper or faulty field operation spells success or failure to the whole project, as the case may be.

The following phases in their respective order may be considered as fundamentals:

Field Operation.

Plant Operation.

Marketing the Product.

Back of all this the peat executive must know to a certainty that the deposit, for ferilizer use exceeds 3 percent Ammonia, on a 10 percent moisture basis:

That the drainage is such that it will not flood during the working season:

That the acreage and tonnage output, on a dry basis, are sufficient to justify the cost of a plant which can be written off at the rate of not less than 5 percent and preferably 10 percent per annum. It must be understood that the plant will have very little value when the bog is exhausted:

That local weather records, such as rainfall, humidity and frost should be consulted covering a period of 10 to 20 years, in order to strike an average of possible working days suitable for gathering the raw material in proper condition for economical drying, in sufficient excess to guarantee continuous plant operation from the stock pile during all times, when hauling direct from the field is not economically possible, or is interrupted by any cause:

[1] Delivered at the Sixteenth Annual Convention of the American Peat Society at South Bend, Ind.

That the consuming markets in relation to the peat deposit are readily accessible at low freight cost.

With these facts the figures known, plans for operation may be laid down with reasonable chance of success.

It goes without saying that the peat executive has carefully considered the present state of the art in field-gathering machinery, and has secured a field foreman who can adapt himself to the discomforts often present on a peat bog, and who has some engineering experience, as well as knowledge of machinery and the economical handling of labor.

In a mine or factory steady employment at stated tasks is assumed; but the gathering of peat is akin to an agricultural process, subject to weather conditions, much as is the harvesting of hay to the farmer.

Just as the farmer must place his labor to best advantage during unfavorable weather conditions so must the field foreman utilize his labor when the weather precludes field work. He may do this by clearing and ditching new areas or concentrate on hauling to the stock-pile sun-dried material already windrowed along his tracks; or on simple construction work—track and other repairs—of which there is always much to do.

The peat must be very cheaply handled and properly sun-dried before going to the stock pile. If this detail is properly accomplished the final drying operation is comparatively simple, as practical plans of artificial drying of peat have been worked out to a point at least where the operation is both simple and feasible.

When it comes to marketing the product to the fertilizer manufacturer, the peat executive should realize first, last, and always, that a contract to deliver a stated tonnage of dry peat at the time the contract calls for, means just what it says, subject only to the acts of Providence, beyond the control of buyer or seller.

Inability to fill contracts has been the most serious handi-

cap to the business, and has prevented the more extended use of this product in the fabrication of mixed fertilizer.

The manufacturer of chemical fertilizer is compelled to receive, mix, and ship a large tonnage in a short space of time, to meet the Spring and Fall planting season. His raw material storage space cannot care for his entire output of finished goods. He must necessarily contract months ahead for his raw materials, and must be sure they will arrive when needed.

When dry peat can be delivered with the same assurance as other fertilizer raw materials, the consumption of this product will run into an annual tonnage never before thought possible.

As you may know, organic ammoniates, including those derived from peat, are requisites to a well balanced fertilizer and they command a higher price than water soluble mineral ammoniates. The ammonia in peat is not water soluble; if so, it would not be there. It would be leached out. The same applies to other organic ammoniates. When, however, dry peat ammoniate is mixed with acid phosphate and other chemical plant foods chemical action takes place which renders the peat ammonia more soluble and available especially if the mixed fertilizer is confined in large bins or silos for a time before bagging and shipping.

Heretofore animal tankage, fish scrap, cotton seed meal and some garbage tankage were utilized. Due to the extensive diversion of these products as ingredients of animal foodstuffs, the use of organic ammoniate from peat must be substituted to fill the void, and cheapen the cost of manufactured fertilizer to the farmer.

Entirely aside from the ammonia content, peat, because of its wonderful absorbtive power will quickly convert sticky fertilizer mixtures into dry, lively material, which will remain in powder form indefinitely and act well in the drill.

As a conditioner it has no equal. It will tend to correct pastiness due to excess acid in acid phosphate. It can be used to great advantage in converting stick tankage (which is concentrated waste tank liquor from meat and bone degreasing

tanks) into material fit to use in fertilizer mixtures, without the danger of the whole mass consolidating. It will absorb noxious odors and thus act to some extent as a deodorant. It makes a much better filler and make-weight than sand and similar inert material. It bulks up the fertilizer mixture due to its light weight, and while acting as a filler, it is composed mainly of materials from which the growing plant derives benefit.

The extended use of peat ammoniate will give the farmer cheaper fertilizer, and enable him to use more per acre, and fertilize more acres.

It will enable the fertilizer manufacturers to enjoy a larger output, with increased profit, and ultimately, through the more extended use of mixed organic plant foods, reduce the cost of food products to the ultimate consumer.

The successful peat executive must be familiar with the market situation and also know that the mechanical condition and chemical qualities of his product are up to requirements.

Sales of fertilizer raw materials are generally effected through brokers, rendering a sales force unnecessary to distribute this peat product. It is usually sold for cash, at a stated price per unit of ammonia, with guarantee of the maximum moisture content.

In case natural or composted peat, or humus, is to be produced and sold, the administrative phases of a selling campaign sales force and publicity work must claim a large share of attention. And here expert agricultural knowledge as to the proper use of manure, and other organic fertilizers, and different types of soil and the requirements of each to restore their fertility should be known, to properly handle this part of the business.

The ultimate consumer must be educated; even the advertising must be largely prepared by someone experienced in scientific agriculture, chemistry and bacteriology; and the salesman must be more or less proficient along these lines to attain any large measure of success.

One more absolute essential is a careful system of daily

plant reports, covering production costs as well as administrative and selling expenses. There are few ventures which appear more outwardly simple and alluring, and are inwardly more complex and baffling than the production of peat and its products for fertilizer, or soil improvement, or for that matter, any other practical use to which peat and its products lend themselves.

PEAT SOILS IN VEGETABLE PRODUCTION.[1]

By W. R. Beattie,
Extension Horticulturist,
Bureau of Plant Industry.

The subject assigned me by your program committee, "Peat Soils in Vegetable Production," is one of such magnitude that it will be almost useless for me to undertake in the time alloted to more than outline some of the possibilities. According to the statement appearing in the advance program sent out by your secretary, there are 12,000 square miles or 7,680,000 acres of muck and peat lands in the Great Lakes and New England States. Assuming that one-half of this area is susceptible to drainage and otherwise being put in proper condition for the cultivation of certain vegetable crops, we have possibilities of production far beyond the needs of this country during the next thousand or more years.

The range of crops that are adapted to growing on this class of soils is necessarily somewhat limited, and therefore, the development of muck soils for vegetable growing will always be subject to the market demands for those particular crops.

We have in our muck lands a natural resource comparable only to those of our coal, iron and timber, a resource which should be conserved and maintained for future generations as should those of the other natural resources that have been so subject to exploitation and extreme waste. Fortunately the exploitation and waste of our muck soils has not gone on to the extent of those of other lines and there is still time to adopt measures that will properly conserve our muck soil resources for the future.

I desire to call your attention briefly to some of the

[1] Read at the Sixteenth Annual Convention of the American Peat Society.

possibilities of the use of muck soils in vegetable crop production, treating the matter from two standpoints; first, that of growing the crops directly upon the muck soils in their natural location, and, second, the use of muck soils for mixing with other soils in the production of specialized crops in greenhouses and elsewhere. In making a survey of the possibilities for growing vegetable crops on the muck lands in the open we have first to consider what crops may be profitably grown upon these soils, and, second, the quantity of these crops required for the market. Celery, lettuce, spinach, kale, cabbage, cauliflower, onions ,sweet corn, and mint are among the most important crops now being grown. Recently it has been found that a number of additional crops are adapted to growing on muck land. In the greenhouse, cold frame and in specialized trucking gardens, muck soils are becoming an important factor for the general improvement of the natural soils. With the growing scarcity of manure we must look to some other source for our supply of humus with which to improve the texture and water holding power of our greenhouse and special garden soils. With the increasing cost of nitrogen we turn to muck as a source of this element. The old theory that roses, carnations and similar flowers can be grown only on a soil composed of decayed sods and cow manure has been completely exploded and it is found that a soil composed of sod loam and muck will give more satisfactory results. Experiments have also demonstrated that the quality of the flowers so produced is superior to those grown on the old type of soil.

Time will not permit a detailed discussion of the growing of the various crops in the open upon muck soils. It should be stated, however, that the various deposits of muck differ widely, both as to physical qualities and chemical composition. For this reason cultural rules that would apply to one section would not prove satisfactory for another. This condition, however, is not characteristic of muck soils, but is one that is found in connection with all garden soils. Our muck soils, as we are well aware, vary greatly as to their nitrogen content.

This is a factor of extreme importance when the soil is considered from the standpoint of its use as a conditioner for other soils. It is conceded that the majority of the muck soils are deficient in potash and therefore, liberal applications of potash fertilizer, both in the field and in the greenhouse have given marked results. Recent investigations on the part of Dr. Hartwell of the Rhode Island station and others have shown that many soils border very closely upon the line of acidity and alkalinity and that they may be thrown to one side of the line or the other by so small a factor as the source of nitrogen contained in an application of commercial fertilizer, amounting to one ton to the acre. I take it that this condition will apply equally to many of our muck deposits, especially after proper drainage and aeration has been secured. We have, therefore, before us a most important problem in the study of muck soils for the production of vegetables to determine the relations of fertilizing elements that should be used in balancing up the supply of plant food in the soil. What appears to be nitrogen starvation is found in some cases to be a shortage of some other element and land containing a maximum of nitrogen but which is deficient in potash gives the same result as that which is deficient in nitrogen. What appears to be a deficiency in phosphoric acid may prove to be due to the physical condition of the soil. What appears to be lack of plant food and general starvation of a given crop may be the result of the wrong crop rotation and a crop like onions requiring an alkaline condition following a crop grown under an acid condition. All of this illustrates the need for a great amount of experimentation, observation and study of the various factors and conditions that govern the production of vegetable crops not only upon muck soils but upon all classes and types of soil. The future of the use of our muck soils for vegetable production will depend largely upon the determination of the various factors entering into the controlling crop yields.

The development of specific varieties and strains of vegetable crops for use on muck land is one of great importance. Thus far comparatively little has been done in this line. At

the Arlington greenhouse we have found that in order to get good strains of tomatoes, cauliflower, lettuce and cucumbers that are distinctly adapted for growing under glass we must produce the seed itself under the same general conditions and that we get farther in the matter of selection and improvement where the work is done under the same set of conditions as those under which the crop itself is grown. This applies equally not only to muck soils in general but to specific types of these soils, and until our vegetable growers who are working upon muck soils give more attention to the question of strain improvement and variety adaptation we are not going to get the highest yields. The work being done at the South Bend Station of the Department is commendable in that it undertakes to solve for that class of muck soil upon which the work is being done such problems as fertilizer requirements, quantity and method of application of the fertilizer, strain adaptation, disease control and the many other elements that enter into the successful production of vegetables on muck soils of the type found in northern Indiana. These results will give indications applicable to the muck soils of other regions, but subject to checking up and further determination.

The growing of vegetable crops on muck soils is comparatively new. I might say almost in its infancy No one can predict the future but it is safe to prophesy that these soils will, as the years go by, greatly increase in value and become a constantly increasing factor in the production of a large supply of the class of vegetables which are especially adapted to growing upon them. From a commercial standpoint you will be told of the great possibilities of peat as a feul, also of the uses of peat for general commercial purposes, and while the deposits of this important material are measured by the thousands of square miles, I want to repeat the warning that I have cited in the past that these acres of muck soil are one of our natural, national resources which should and must be conserved for future generations. An acre of peat will yield many tons for commercial purposes but, in most cases when once mined it is gone; whereas, if retained as agricultural land

or held in reserve for later development it will continue to yield in food supply for hundreds of years. We should adopt a conservation policy whereby the cultivated muck lands will not be allowed to blow away, burn or deteriorate in value. This must be accomplished in most part by a judicious cropping system. There can be no question as to the value of these soils, especially for the production of lettuce, celery and onions and the possibilities with other crops have scarcely been touched upon.

PEAT FUEL RESOURCES OF THE UNITED STATES.[1]

BY C. C. OSBON,

Formerly in charge of peat investigations for U. S. Geological Survey.

In recent years the realization that the known and probable oil reserves in the United States are limited at the present rate of consumption to less than half a century, and that the supply of coal will be sufficient to meet the needs of the people for only a small fraction of the time we anticipate as the life of the nation, has directed attention to other fuel resources. Because of its high content of carbon and because it will ignite and burn freely when dry, making a hot fire, peat has often been suggested as a practicable substitute for these fuels for industrial and domestic use. The purpose of this paper is to point out the peat fuel resources of this country, to discuss the occurrence, distribution, and physical and chemical properties of peat, and to outline briefly its possibilities for power production and heat treatment. A succeeding paper will be devoted to a discussion of the technical phases of peat fuel production and utilization.

In Europe between 15 and 20 million tons of peat are consumed annually. Peat has been the only fuel of the common people in Ireland from the traditional time when the country was deforested. The peat fire on the hearth, like the jaunting car, typifies Irish environment, and when the tourist seeks a memento of his visit to that country he usually selects some souvenir carved from the black oak that has lain for centuries protected by beds of peat from the attacks of fungi and bacteria. Peat is cut by hand in blocks by the peasants for domestic use, and machine-cut peat is sold in blocks for both domestic and industrial use.

[1]Reprinted from the August, 1922 edition of Combustion.

Only small quantities of peat fuel have thus far been produced in the United States, largely because of the abundance of coal. The interest shown in its possibilities has been chiefly scientific and experimental. In recent years the increasing cost of producing coal and of transporting it to the consumer has led to a large advance in price. This condition, coupled with an appreciable reduction in the visible coal supply, the rapid exhaustion of our forests, and the material depletion of the oil reserve, has strongly impressed upon economists and others the necessity of conserving these materials by investigating and substituting other fuels and sources of power wherever they can be more economically used.

Operators say that air-dried machine peat can be produced in the United States at a cost ranging from $1.50 to $5.00 a ton, the exact figure depending on the size and efficiency of the plant. In many places where peat fuel has been used in this country it has proved satisfactory and has found ready sale as fast as produced. A peat fuel industry of national proportions would not be successful so long as our vast reserve of coal remains available. However, the coal shortage of 1917 and 1918 showed that peat fuel may be profitably made and sold in regions where coal is scarce and expensive, where good peat is abundant, and where, on account of a cold climate and extensive manufacturing industries, large quantities of fuel are needed. This condition prevails in New England and to a considerable extent in the Great Lakes States. The peat deposits are largely located in regions remote from the coal fields. Although the prospects for a commercially successful peat-fuel industry are now probably limited to regions remote from the coal fields, it seems that ultimately, when our reserve of high-grade coal is consumed, there will be a general demand for other fuel, and unless heat and power are obtained from other sources, a large peat-fuel industry will be created in this country. When peat is used commercially it will be converted into fuel in the form of machine blocks, powder, and gas, and possibly briquettes.

Occurrence and Distribution

In 1918 the United States Geological Survey began a comprehensive investigation of the peat resources of this country. The author of this paper was engaged in that work which required two years. The results of that investigation are contained in a report that is now in process of publication. A summary of the conclusions reached show some striking facts to persons interested in the fuel problem.

The total quantity of peat in the United States, exclusive of Alaska, calculated on an air-dried basis, is almost 14 billion tons. The most valuable deposits may be roughly assigned

Distribution of Peat in the United States.

to two general regions—the northern or glacial, and the Atlantic coastal—and this division, though partly geographic, indicates the chief differences in origin and in the quality of the peat. The accompanying map illustrates this distribution.

The northern peat region, which contains the most extensive deposits in the United States, includes Minnesota, Wisconsin, Michigan, eastern South Dakota, the northern parts of Iowa, Illinios, Indiana, and Pennsylvania, and New York, New Jersey and the New England States. This region is characterized by numerous ponds, marshes and lakes formed by glacial action during Pleistocene time and by relatively low temperature and high humidity in the growing season. Most of the peat originated in basins. Probably the largest peat deposit in this country is in the northern region. It covers nearly 4,000 square miles, or about 2,500,000 acres, in Beltrami, Koochiching, Roseau, and Marshall counties, Minnesota. The Great Lakes States contain a larger quantity of high-grade workable peat than all other States. New England has many climbing bogs and much sphagnum peat, the most extensive deposits occurring in Maine and Massachusetts. It is estimated that in Maine alone there are deposits which would yield one hundred million short tons of air-dried peat. New England peat is of good quality. The depth varies from 1 to 50 feet.

The Atlantic coastal region, which contains many workable deposits, embraces the southern part of Deleware, the eastern parts of Maryland, Virginia, North Carolina, South Carolina, and Georgia, and all of Florida. The nearness of the ocean causes heavy rainfall and high relative humidity in this region, and the deposits occur in drowned valleys and lagoons which were formed by the gradual subsidence of the coastal plain and by wave action, and on flat imperfectly drained areas farther inland. This region is characterized by many salt and fresh water marshes and swamps, in which the deposits have been formed largely by trees, sedges, and marsh grasses, some of the grasses tolerating salt water around their roots. The largest deposits of good peat in this region are found in Virginia, North Carolina, and Florida.

Although there are a few peat deposits along the coasts of New England and New Jersey that are related in origin and composition to those assigned to the Atlantic coastal region, by far the most numerous bogs of the Northeastern

States are of the filled-basin kind, and these states are therefore classed in the northern region.

The following table shows the availability of peat in this country by states:

Approximate Distribution and Quantity of Peat in the United States (Estimated as Air-dried).

State	Area (acres)	Quantity (short tons)
Northern region		
Minnesota	5,217,000	6,835,000,000
Wisconsin	1,000,000	2,500,000,000
Michigan	.....	1,000,000,000
Iowa	.....	22,000,000
Illinois	42,000	10,000,000
Indiana	.....	13,000,000
Ohio	50,000	50,000,000
Pennsylvania	.....	1,000,000
New York	800,000	480,000,000
New Jersey	.....	15,000,000
Maine	.....	100,000,000
New Hampshire	.....	1,000,000
Vermont	.....	8,000,000
Massachusetts	.....	12,000,000
Connecticut	.....	2,000,000
Rhode Island	.....	1,000,000
		11,050,000,000
Atlantic Coastal region		
Virginia and North Carolina	.....	700,000,000
Florida	.....	2,000,000,000
Other States	.....	2,000,000
		2,702,000,000
Other regions		
Gulf Coast	.....	2,000,000
California	60,000	72,000,000
Oregon and Washington	.....	1,000,000
		75,000,000
Grand total		13,827,000,000

Process of Formation

The nature of peat and its mode of formation are among the most interesting features of geo-chemistry. Peat is the partly carbonized organic residuum produced by an arrest in the decomposition of roots, trunks of trees, twigs, seeds,

shrubs, mosses, and other vegetation covered or saturated with water. It contains a large proportion of the carbon of the original vegetable matter, and its vegetal structure is generally visible without the microscope. It is usually acidic and contains much less inorganic than organic matter. In fact, some pure peats contain less than 4 per cent of inorganic matter. Peat is therefore almost universally a surface deposit. Obviously it forms under conditions favorable to the profuse growth of plants and to the escape of the plant debris from complete decomposition by bacterial and chemical action. Hence it is clear that the accumulation of this material is governed very largely by topography—that is, the configuration of the surface of the land—and by climate. If the land surface contains depressions, or flat, gently sloping, poorly drained areas in which water may collect and stand perma-

Fig. 1. Built-up peat deposit formed on a relatively flat surface

nently, and if the temperature of the air and the soil is low in summer or the humidity of the air is high enough to prevent rapid evaporation, peat forming plants will flourish.

One of the chief substances formed by plants during their growth is cellulose ($C_{72}H_{120}O_{60}$), which consists of carbon hydrogen, and oxygen. These constituents are absorbed by the leaves from the atmosphere and by the roots from the

soil. Cellulose, because of its complex composition, is an unstable compound and when attacked by fungi and bacteria decomposes rapidly. If at the end of the growing season the plant debris falls upon drained soil it is vigorously attacked by these micro-organisms and the carbon and hydrogen of the cellulose unite with the atmospheric oxygen and with each other, forming carbon dioxide, water, and marsh gas. In other words, if oxidation is unhampered the organic matter will disappear in a relatively short time. If, however, the plant matter falls into water or upon soil saturated with moisture it undergoes a change different from the decay suffered by exposed vegetation. The atmospheric oxygen is largely excluded, and as the activity of fungi and bacteria is controlled by the supply of air, upon which they depend for their existence, decay is slow, the plant debris becomes buried, and a large proportion of the fixed carbon is retained. The salient features in the production of peat (C_{62} H_{72} O_{24}) from cellulose (C_{72} H_{120} O_{60}) are the elimination of hydrogen and oxygen as water (H_2O) and of carbon and oxygen as carbon dioxide (CO_2) and the generation of methane (CH_4). This results in the concentration of the carbon. It is called the process of carbonization.

If the surface conditions are unchanged, carbonization is largely arrested with the formation of peat, and the accumulation of organic matter may exist indefinitely as peat unless the land is drained and decomposition begins again, or unless the peat is deeply buried beneath superposed deposits, generally muds, sands, limestone, and other sedimentary beds, and subjected to pressure accompanied by heat. Lignite, bituminous coal, anthracite, and graphite are succeeding stages in the process of carbonization of the buried vegetable debris. Most coals were once peats; most coal fields were formerly swamps, and the formation of peat in the bogs and swamps of this country today is an example of the first stage in the process of coal formation. Deposits essentially similar were laid down in many parts of the United States during the Carboniferous, Triassic, Cretaceous, and Tertiary periods.

Figures 1 and 2 illustrate the surface and sub-surface appearance of typical peat deposits.

Physical and Chemical Properties

Raw peat, as already stated, consists of partly decayed vegetable matter, inorganic minerals, and water in varying

Fig. 2. Cross-section of composite peat bed near New Haven, Conn., showing layers of salt and fresh water peat.

proportions, the usual ratio being 10 percent of solid matter to 90 percent of water. The elimination of the excess moisture is a technical problem that will be discussed in a succeeding paper. The water content may be reduced to between 25 and 30 per cent by exposure to the sun and the wind. These figures represent the moisture content of typical commercial air-dried machine peat fuel.

The following classification of peats by physical characteristics includes all types found in the United States:[1]

Turfy peat.—Consisting of slightly decomposed mosses and other peat-producing plants, having a yellow or yellowish-brown color, very soft, spongy, and elastic; specific gravity, 0.11 to 0.26, the full English cubic foot weighing from 7 to 16 pounds.

Fibrous peat.—Unripe peat which is brown or black in color, less elastic than turfy peat, the fibres either of moss, grass, roots, leaves, or wood, distinguishable by the eye, but brittle and easily broken; specific gravity 0.24 to 0.67, the full cubic foot weighing, accordingly, from 15 to 42 pounds.

Earthy peat.—Nearly or altogether destitute of fibrous structure, drying to earthlike masses which break with more or less difficulty, giving lusterless surfaces of fracture; specific gravity, 0.41 to 0.90, the full cubic foot weighing from 25 to 56 pounds.

Pitchy peat.—Dense; when dry, hard; often resisting the blows of a hammer, breaking with a smooth, sometimes lustrous fracture into sharp-angled pieces; specific gravity, 0.62 to 1.03, the full cubic foot weighing from 38 to 65 pounds.

A detailed study of more than 500 samples of peat taken from deposits in different parts of the peat regions of this country leads to the following conclusions concerning its chemical properties.

Peat consists of carbon, hydrogen, oxygen, and relatively small quantities of nitrogen. Although the exact atomic re-

[1] Johnson, S. W., Peat and its uses, pp. 95-96, New York, 1866.

lations of its principal elements are not known the following table shows its composition (ash and moisture omitted):

Carbon	59.50
Hydrogen	5.50
Oxygen	33.00
Nitrogen	2.00

The quantity of "fixed" or "free" carbon generally varies from 10 to 60 per cent, the remainder being combined with other elements. Volatile matter usually ranges from 25 to 70 per cent and moisture from 15 to 30 per cent in air-dried peat. As the volume of oxygen is relatively high peat ignites readily and burns freely, leaving little unconsumed residue. Sulphur usually ranges from 0.2 to 0.6 per cent and nitrogen from 1 to 4 per cent, the average for nitrogen being about 2 per cent.

The ash in native peat, which renders it more or less impure constitutes from 3 to 30 per cent of its dry weight. The best types contain from 6 to 12 per cent, though many of the largest deposits in the Great Lakes area contain 15 per cent.

The value of peat as fuel is dependent upon many factors, chief of which are the degree of decomposition (density), heating value and ash content. Course-textured, fibrous peat is inferior for fuel to black, compact, thoroughly decmposed peat, except kinds that contain a very large proportion of ash. The heating value of good moisture-free raw peat, which ranges from 6,000 to 10,000 B. t. u. per pound, is determined chiefly by its content of fixed carbon and ash. Though the ash is inert it displaces an equal volume of combustible matter and absorbs heat in maintaining its temperature at the same degree as the accompanying carbon. The maximum quantity of ash that may be considered allowable in peat for commercial use is usually placed at 20 per cent. The heating value of peat of any moisture content up to 30 per cent may be ascertained by deducting 1 per cent from the calorific value determined as of water free for each per cent of moisture.

The tables below show a comparison of the value of peat prepared in several commercial ways with that of other kinds of fuel in common use.

Caloric Values of Peat and Other Fuels

Kind of fuel	Calorific Value B.t.u. per lb.
Wood	5,760
Air-dried cut peat	6,840
Pressed peat (machine blocks)	7,290
Bituminous coal	11,000
Gas coke	12,060
Peat coke	12,676
Lignite	7,500
Semi-bituminous coal	13,000
Peat briquettes	13,330
Charcoal	13,840
Anthracite	14,600

These comparisons clearly demonstrate that peat is a better fuel than wood or many grades of lignites, and at its best is not much inferior to some grades of commercially important coals, although generally considerably poorer. The best peat has about 75 per cent of the heating value of anthracites and about 80 per cent of that of the Illinois coals, or from 85 to nearly 90 per cent of the Wyoming samples. These comparisons are made on a strictly commercial basis, the peat being air dried and the other fuels in the state in which they were received from the mines.

It is said by many combustion engineers who have experimented with peat that the above comparisons are not entirely fair to peat. Peat contains more oxygen than coal and there is little unconsumed residue, thereby affording increased boiler efficiency.

Summary of Advantages and Disadvantages

The United States contains 14 billion tons of peat, much of which is located in regions remote from the coal fields and close to commercially important manufacturing centers. A large part of this peat is well adapted for use in heat treatments and for power production. In some instances it could be

used at the bog for the generation of electricity. There are enormous deposits in New England that could be used by the lime and textile industries at a cost lower than coal. Air-dried peat is less dense and therefore yields less heat per unit volume than coal. Peat can not be transported long distances at a price that is economical, but much of it can be used by local industries. It is lower in theoretical calorific value per pound than coal. The amount of fines is about 10 per cent. These disadvantages relate largely to air-dried peat. When macerated and made into blocks, briquettes or powder some of these disadvantages are partly offset. In the case of peat powder combustion is instantaneous and it burns like gas throughout the entire combustion chamber.

There are some respects in which peat has advantages over coal. It gives up more of its heat units in proportion to its theoretical calorific value than coal, when used in an industrial furnace. This is due in part to the low ash and high oxygen contents of peat. Peat produces little or no smoke and leaves no soot or other objectionable deposit. It is quickly ignited and leaves no clinkers.

(To be Continued in January, 1923, number)

DIRECTIONS FOR DOMESTIC USE OF PEAT FUEL.

By Peat Committee of Canada

It is an acknowledged fact that very few people have any correct idea of the economical use of fuel of any kind. Everybody is supposed to know how to burn wood, but very few burn it economically or even prudently.

The waste of wood is immense, so also of coal. It was a long time after hard coal was introduced before the community became even tolerably familiar with its use, but at the present time it is otherwise. With plenty of kindling wood, an abundant supply of coal, a clear grate, and a strong draught, a good fire is started and kept up regardless of expense, but for a moderate fire on a mild day, or for light services, few are skillful enough to kindle or maintain it.

Those who use peat for fuel should understand that it ignites quickly, burns freely, and gives a quick, intense heat. It is therefore reasonable to suppose that it should be managed somewhat differently from coal or wood.

About 60% of the total weight of peat fuel is volatile, and if proper precautions are not taken a large quantity of useful heating value will be wasted, or the fire may get beyond control.

Peat fuel has been found very satisfactory for the following domestic uses:—

For open grate fires.

For Fall and Spring use in the furnace.

As a kindling and for auxiliary use with coal during the severe winter months.

For the cooking range.

For use in Quebec heaters.

Peat fuel is more easily ignited than coal, requires much less draught, except just as the fire is being started, and a much less quantity should be used to make a fire, though it

must be renewed more frequently. Peat ignited and covered with ashes will keep a fire equal to the Yule Log, can easily be kept alive over night even in cook stoves, and by merely reopening the dampers and adding a small quantity of fresh fuel, a surprisingly active fire is quickly rekindled.

Peat does not clinker, and burns to a very fine light clean ash. No unburned carbon is left, and in this respect peat is more economical than coal.

For Grate Purposes

When a fire is wanted, use some paper and a small quantity of kindling less than for coal, and put on, say, five or six blocks of peat, filling the spaces between with the smaller pieces. Open up the draught in the chimney and then if possible close up the front for a few moments until a bright clear flame is burning above the fuel. Draughts can then be closed off, as found desirable, and a cheerful, brisk fire will result for some time. As soon as the flame has died down, fresh fuel may be added, a couple of blocks at a time, as found necessary, and in this way a body of glowing coals can be built up in the grate, which will retain heat for a long time, if not disturbed.

Do not put on too much fuel at a time and let the fire get well started before closing off the draught.

There is no soot, spitting, or little black particles floating around from a peat fire, but if improperly handled and the light smoke gets into the room, an odor of burning leaves results. These fumes however, are not in any way harmful.

For Use in the Furnace

There is a period in the Fall and Spring when a coal fire in the furnace is hard to handle. If the fire is kept burning sufficiently vigorous to keep alight, the house becomes too hot, usually the windows are opened and heat wasted; otherwise, the fire goes out, with the attending inconvenience and loss of unburned coal, as the furnace is cleaned out and a new fire started. With peat this difficulty does not occur.

When it is desired to take the chill out of the house, start a fire in the furnace very much as described for the grate. Do

not put on too much fuel, and give the furnace all its draught until the fire is burning well. On a mild day, a quick hot fire obtained will heat the house through more quickly than a coal fire kindled at the same time, and the draughts may then be closed and the fuel will smoulder away all day until the late afternoon, when another quick fire can be made without further trouble than adding more fuel and opening up the draughts.

In colder weather more peat may be fed from time to time as found necessary, and a bed of coals built up in the fire box, which will remain alight all night and ignite fresh fuel in the morning.

For furnace use, however, best results are obtained by using the smaller pieces of peat. The larger blocks should be broken up from the size of stove coal down, so that a fuel bed may be obtained without air shafts, as would be the case if only the larger blocks were used. These large vents make the fire very difficult to control.

As an auxiliary to coal in the severe winter months, peat is an excellent material with which to kindle a hard coal fire. It is also a great convenience, supposing a hard coal fire has become low and it is desired to wake it up quickly. Ordinarily, the furnace is shaken down, new fuel added, and the draughts turned on. Instead of doing this, a few blocks of peat may be thrown on top of the fire and the draughts opened without disturbing it; surprising results will be thus obtained. The coal fire will be brought up to more intense combustion, and in this way quick results and economy of fuel are obtained.

For Cooking Ranges

In the cook stove, the peat fuel fire is built similar to what has already been described; again with the precaution of not putting on too much fuel and having the fuel broken up so that it forms a complete covering in the fire box. To get satisfactory results, a good draught is necessary until the first fire has been well started, and the draughts may then be entirely closed off; fresh fuel in small quantities may be added from time to time, and a little experience will give very satisfactory results, in that the peat fire can be controlled so read-

ily, a little extra fuel and the draughts open for a short time giving a quick, hot fire, which can be dampened down again almost as quickly. In summer this is a great advantage.

For Surface Heaters

In surface heaters, such as the Quebec Heater, in fact, almost any stove not a Self-feeder, peat blocks may be used very much as wood or gas house coke. With stoves of the air-tight variety, a comparatively small quantity of peat can be kept alight for a very long time, as a block of peat once ignited will keep burning until completely consumed, even when the air is practically all closed off.

PEAT is almost twice as bulky as coal, and although it may appear that a large quantity is being burned to obtain results, by actual weight, it will not be found so great.

Do not become discouraged if satisfactory results are not obtained with your first fire. Peat is a new fuel in this country, although it has been used almost exclusively for many years in some parts of the Old World. When hard coal was first introduced, the complaint was made that the "black rocks" could not be burned at all, and it was only after patient trial that the present satisfactory methods of burning were arrived at. Peat is not offered as a substitute for coal, but rather as a supplementary fuel to conserve the higher grade fuel, which is becoming more expensive and less plentiful. Every pound of peat used in place of hard coal means so much money kept in Canada, that would otherwise go outside; and every pound of peat used helps a little towards the conservation of our fuel resources.

NEWS OF THE INDUSTRY.

Minnesota

TWIN CITY COMPANIES START PLANT TO WORK AT CORONA, MINN.

If the people of Duluth, Superior and the iron ranges and other places in this north country would get together and set about manufacturing fuel from peat, they would not alone save on costs and help to relieve the Northwest from the present fuel panic, but the tendency would also be in the direction of more or less complete emancipation from the heavy tolls exacted by the coal barons of the Ohio Valley states. Besides, such action would have far-reaching and beneficial effects upon local industries and development of our own resources, according to H. W. Richardson, U. S. meteoroligist in Duluth.

Peat Being Manufactured

The St. Paul Dispatch Printing company, the Itasca Paper company at Grand Rapids, and the Minneapolis Atomized Fuel company are jointly engaged in a practical demonstration of this idea on the big peat bog at Corona, about twelve miles beyond Carlton, on the Northern Pacific railway. The concerns mentioned are stockpiling peat and will pulverize it for use in that form, and some will also be briquetted. Although operations were got under way in good earnest but recently, several hundred tons of peat are already piled ready for final handling. The machinery for the work was built by Duluth people, and is guaranteed to dry, powder and load in box cars at a rate of twenty tons in ten hours per unit. The claim is made that by attaching an additional revolving drum the ten-hour unit output can be increased to forty tons.

Costs of Operation

The main operation costs to date are reported to be running about as follows:

Dredging	$1.60 per ton
Drying and powdering	1.25 per ton
Freight to Duluth-Superior	1.49 per ton
Total	$4.34 per ton
If briquetted	2.50 per ton
Total	$6.84 per ton

The St. Paul Dispatch Printing company and the Itasca Paper company each concluded to make this attempt to secure necessary fuel in this way because of the present coal shortage and possible extortionate prices later on. The Minneapolis Atomized Fuel company has been in this field for some time and represents a reorganization of a corporation which operated under somewhat the same name.

These people have gone quietly ahead, Mr. Richardson says, have done a lot of experimental work involving considerable expense, and already have accomplished much as regards making it possible, or rather leading the way for the people of Minnesota and Wisconsin to achieve fuel independence. As is well known there are enormous deposits of peat in the northern portions of Minnesota and Wisconsin, the fuel value of which averages high and altogether comparable with coal for heating purposes of every kind.—Duluth Herald, September 23, 1922.

Maine

MAKING PEAT MOSS NEW LOCAL INDUSTRY

High grade peat moss is being produced by the Peat Engineering Co. of Bangor as a by-product of operations in peat for fuel.

Fred T. Dow, inventor of the peat drying process, has used his remarkable drying press for the production of dried moss, and florists, who have been importing moss for many years, are finding it a very desirable article for their use, as also are poultry farmrers and packers of fragile articles.

The Peat Engineering Co. is unable at present to say

when arrangements will be concluded with a manufacturing company for production of peat fuel on a large scale here, but a company is all ready to proceed when negotiations for rights and royalties shall have been completed. These matters have been pending some time, but it is believed that the delays are nearly at an end.—Bangor News, June 24, 1922.

Canada

PEAT EXPERIMENTS

The Ontario Department of Mines will conclude its experiments in the manufacture of peat in the Alfred bog with this year's operations, when it is hoped that the committee in charge of the work will have sufficient data to report with reasonable definiteness as to whether or not peat manufacture can be carried on on a basis of making it possible for the product to compete successfully with coal.—Hartford Times.

The Peat Industry of East Prussia.

(By Consul Alfred W. Donegan, Konigsberg, Germany.)

Owing to the present high prices of coal and the decreasing supplies the peat deposits of East Prussia are being developed to meet the increasing demand for this fuel.

The strata of peat are situated in the swamp districts of East Prussia, chiefly on the banks of the Kurishes Haff and the Rivers Pregel and Dieme. The layers cover an area of about 260,000 hectares (624,200 acres) and have an average thickness of 2.5 meters (8.2 feet). The total deposits in the Province are estimated at 1,000,000 tons. The consumption in 1921 was approximately 250,000 tons.

In this Province the so-called machine twisted peat is produced. The peat is dipped by motor-driven elevators in the peat-twisting machines, where it is mixed, kneaded, and compressed to the desired density and water-tightness. When the peat strips are taken from the machine they are cut in small blocks, automatically or by hand, and, after a thorough sun drying, are turned over to the trade. Good peat should not contain more than 25 per cent water, in which case its

heating power is approximately 50 per cent of that of hard coal, and almost 100 per cent of brown coal.—Commerce Reports, July 17, 1922.

Italy

EXPLOITATION OF ITALIAN PEAT BEDS.

The following translation of an article, which appeared in the Popolo Romano of December 2, 1921, regarding work which is being done at the peat deposits of Campotosto, Abruzzo, Italy, has been released by the Bureau of Foreign and Domestic Commerce:

Prior to the war the exploitation of the enormous peat deposits in Abruzzo was never taken into consideration, owing to the low price of coal. However, on account of high freights, exchange, and increased cost of labor, this work has now been commenced at Campotosto. The deposits are situated in the mountainous district of Laga, 1,300 meters above sea level, to the left of the Aquila-Teramo State road which leads to San Vittorino, Arischia, and Montorio al Vomano. These beds which extend as far as the swamps of Mascioni and Poggio Cancelli, cover an area of 7,750,000 square meters, and vary from 6 to 14 meters in thickness, the total volume being estimated at 50,000,000 cubic meters. The Societa Industriale dell'Aterno, which has commenced the exploitation of the deposit, in less than two years has constructed a huge plant. In addition to the machinery for excavation and working of the peat, building of shelters for 1,000 workmen, store magazines, restaurants, and cooperative ovens have been erected, as well as the laying of railway lines and transport of equipment for transportation of the peat from the points of excavation and drying to the points where it is worked. Aerial railways for the transportation of the material from where it has been prepared to the Railway Capitignano-Aquila are also in operation.

The peat is excavated and pulverized by 45-horsepower Strenge engines. After a certain depth has been reached the engines automatically move on to new points. The peat is worked by groups of Buhler machines actuated by powerful

250-horsepower Tosi boilers. After the peat has been thoroughly dried it is shaped into small briquets, and by means of the aerial railway loaded onto the trains at Capitignano, whence it is shipped to various points in Italy. The aerial railway is capable of handling 800 cubic meters every 10 hours. A gallery 1,100 meters long passing under the Lame Hills carries off the water,

During 1921, the first year of the working of the plant, 60,000 cubic meters of peat were excavated, producing 10,000 tons of briquettes, although an annual production of 50,000 tons is provided for. Itis estimated that 100 kilos of commercial peat is equivalent to the same amount of dry wood, or 40 kilos of Cardiff coal.

Ireland

RECOMMEND PEAT FOR EXPLOSIVES AND FERTILIZERS

Dublin, June 6.—Dail Eiriann's Peat Committee in its final report says Ireland's lowland and mountain peat bogs can develop power cheaply by means of gas engines and on large scale by turbo alternators. Nearly 4,500,000 acres of bog are available.

We are of the opinion that four stations, each of about 20,000 kilowatt constant load, would more than suffice for Ireland's requirements of combined nitrogen for the manufacture of nitrogenous fertilizers and explosives," says the report. They are of opinion that, in the near future, at least one station of 20,000 kilowatt should be erected by the state in a suitable locality. Portion of the electrical power developed can be utilized at the bog for the manufacture of calcium cyanimide and the remainder can be transmitted to centres of industry.—New York Post.

NEWS OF THE SOCIETY.

PROFESSOR CHRISTIANSEN TO EXPERIMENT WITH PEAT GAS.

At the School of Mines Experiment Station, University of Minnesota, preparations are being made to carry on some experimental work in connection with the utilization of peat for the production of producer gas, but up to the present time the producer has just been installed and, therefore, there has been no opportunity to obtain any results.

Professor Peter Christiansen, one of our members, is in charge of the work.

In the commercial field there is a scheme on foot in which Minnesota peat will be mixed with North Dakota lignite for the purpose of manufacturing fuel briquettes. It is believed this could be made a commercial success and would help to benefit the development and conservation of the fuel resources of both states and, at the same time, offer a fair grade of fuel at a reasonable price in a locality where fuel is greatly needed.

Classification of Peat and Muck Land

The following letter was recently received from one of our honorary members, Mr. Milton Whitney, Chief of the Bureau of Soils, Washington, D. C.

"Referring to your letter of July 25, inquiring about the classification of peat and muck soils used by the Bureau of Soils in soil mapping, allow me to say that we have never made any special study of these soils on the basis of their differentation into soil types. Since the areas of such soils are relatively small, and up to the present time have not been widely used throughout the United States, we have not felt justified in spending the time and money necessary to differentiate them very closely. We have been differentiating them more or less roughy merely into peat and muck without other differentation except in some cases making a differentiation on the character of the material lying beneath the peat or

muck as the case may be. We define peat as that material consisting of plant remains not yet in a state of advanced decomposition and in which the character of the plants can be easily determined. The material is not yet finely divided through decomposition or other causes and has a brown rather than a black color.

Muck, on the other hand, is finely divided organic matter in which the nature of the plants from which the material was derived is not readily determinable except through microscopic study. We have never yet undertaken to determine whether this fineness of division is due to a further state of decomposition of the same kind of material as that found in the ordinary peat bed or whether it is due to material that was originally different from that from which the peat is made.

"In most cases, if not all, muck has a higher percentage of inorganic constituents than peat."

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AMERICAN PEAT SOCIETY.

SCOPE AND PURPOSE.

The American Peat Society was organized at the national exposition at Jamestown, Va., on October 23, 1907, and was incorporated in 1912. Its purpose is to disseminate information concerning the origin, metamorphosis, geographic distribution, physical and chemical properties, and uses of peat, muck, and humus, and to stimulate interest in the commercial utilization of the widely-distributed, valuable deposits of these substances in North America.

NATURE AND USES OF PEAT.

Peat is the organic residuum resulting from the arrested decomposition of leaves, twigs, roots, trunks of trees, shrubs, mosses, and other vegetation in areas continually covered or saturated with water. It may be identified as the dark-colored soil found in bogs and swamps, commonly called muck. The commercial uses of peat are numerous and varied. In the countries of northern Europe it is used for fuel and as the basis for many manufacturing industries. Gas, substitutes for petroleum products, charcoal, coke, and a number of valuable by-products are produced in small quantities from it. Peat moss, marsh grass, and fibrous peat are employed in the manufacture of surgical dressings, of rugs and carpets, of packing material, of artificial wood, of paper, and of substitutes for cotton and woolen cloth. In the United States peat is utilized chiefly as an ingredient of fertilizers and stock food and as a crop soil.

ECONOMIC ASPECTS OF PEAT.

The United States contains about 12,000 square miles of undrained land estimated to be capable of yielding nearly 14 billion short tons of air-dried peat. The average deposit will yield 200 tons per acre foot. The peat areas are distributed throughout the Great Lake, New England, and Atlantic and Pacific Coast States. The peat deposits of Canada cover 37,000 square miles. The annual value of the products made from peat in the United States amounts to about $1,000,000. The proceeds received from the cultivation of peat and muck land are far in excess of this figure. European countries annually consume more than 50 million tons.

MEMBERSHIP.

The present membership of the American Peat Society consists largely of agriculturists and peat producers. Persons interested in agriculture, in soil fertilization, in the chemical and bacteriological aspects of vegetal mat-

ter, and in the production of fuel or generation of power are urged to join. Enrollment will be found as valuable by them as it is to the owners and operators of peat and muck areas, who consider their connection with the society a decided business asset. Applications should be addressed to the secretary. Membership and subscription to the journal cost $5.00 a year.

CONVENTIONS AND PUBLICATIONS.

The meetings of the society are held annually in important cities throughout the peat regions. Many original papers relating to the subjects enumerated are presented every year. A quarterly journal containing the proceedings of the society, news of the industry and contemporary literature concerning all phases of the peat and allied industries is published and sent to members. This journal is unique among the scientific publications of the United States, as it is the only one that treats all branches of the peat industry. Its success in stimulating interest in the possibilities of peat, in pointing out the location of deposits, in explaining production methods, in exposing the incompetent engineering practice that has caused many failures, and in stamping out false promotion, has been the subject of favorable comment throughout the world.

General inquiries relating to the objects of the society will be answered free of charge by the secretary or editor, but it should be understood that detailed information will not be so given. Such advice can be obtained from experts whose names will be furnished upon application.

APPLICATION FOR MEMBERSHIP
IN THE
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_____
(Date)

MR. CHARLES KNAP, *Secretary-Treasurer,*
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2 Rector St.,
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Dear Mr. Knap:

Application is hereby made for membership in the American Peat Society. Check in the sum of $5.00 for subscription to the Journal of the American Peat Society during the first year is inclosed. It is understood that the payment of this sum will admit me to the society and entitle me to all the privileges granted to members by the constitution. This action is prompted by my interest in the utilization of peat and the welfare of the society.

Yours very truly,

_____
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_____
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	No. 4	1.10	1.25
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	No. 4	1.10	1.25
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AMERICAN PEAT SOCIETY.

SCOPE AND PURPOSE.

The American Peat Society was organized at the national exposition at Jamestown, Va., on October 23, 1907, and was incorporated in 1912. Its purpose is to disseminate information concerning the origin, metamorphosis, geographic distribution, physical and chemical properties, and uses of peat, muck, and humus, and to stimulate interest in the commercial utilization of the widely-distributed, valuable deposits of these substances in North America.

NATURE AND USES OF PEAT.

Peat is the organic residuum resulting from the arrested decomposition of leaves, twigs, roots, trunks of trees, shrubs, mosses, and other vegetation in areas continually covered or saturated with water. It may be identified as the dark-colored soil found in bogs and swamps, commonly called muck. The commercial uses of peat are numerous and varied. In the countries of northern Europe it is used for fuel and as the basis for many manufacturing industries. Gas, substitutes for petroleum products, charcoal, coke, and a number of valuable by-products are produced in small quantities from it. Peat moss, marsh grass, and fibrous peat are employed in the manufacture of surgical dressings, of rugs and carpets, of packing material, of artifical wood, of paper, and of substitutes for cotton and cloth. In the United States peat is utilized chiefly as an ingredient of fertilizers and stock food and as a crop soil.

ECONOMIC ASPECTS OF PEAT.

The United States contains about 12,000 square miles of undrained land estimated to be capable of yielding nearly 14 billion short tons of air-dried peat. The average deposit will yield 200 tons per acre foot. The peat areas are distributed throughout the Great Lake, New England, and Atlantic and Pacific Coast States. The peat deposits of Canada cover 37,000 square miles. The annual value of the products made from peat in the United States amounts to about $1,000,000. The proceeds received from the cultivation of peat and muck land are far in excess of this figure. European countries annually consume more than 50 million tons.

MEMBERSHIP.

The present membership of the American Peat Society consists largely of agriculturists and peat producers. Persons interested in agriculture, in soil fertilization, in the chemical and bacteriological aspects of vegetal mat-

ter, and in the production of fuel or generation of power are urged to join. Enrollment will be found as valuable by them as it is to the owners and operators of peat and muck areas, who consider their connection with the society a decided business asset. Applications should be addressed to the secretary. Membership and subscription to the journal cost $5.00 a year.

CONVENTIONS AND PUBLICATIONS.

The meetings of the society are held annually in important cities throughout the peat regions. Many original papers relating to the subjects enumerated are presented every year. A quarterly journal containing the proceedings of the society, news of the industry and contemporary literature concerning all phases of the peat and allied industries is published and sent to members. This journal is unique among the scientific publications of the United States, as it is the only one that treats all branches of the peat industry. Its success in stimulating interest in the possibilities of peat, in pointing out the location of deposits, in explaining production methods, in exposing the incompetent engineering practice that has caused many failures, and in stamping out false promotion, has been the subject of favorable comment throughout the world.

General inquiries relating to the objects of the society will be answered free of charge by the secretary or editor, but it should be understood that detailed information will not be so given. Such advice can be obtained from experts whose names will be furnished upon application.

APPLICATION FOR MEMBERSHIP

IN THE

American Peat Society.

_____
(Date)

MR. CHARLES KNAP, *Secretary-Treasurer,*
American Peat Society,
2 Rector St.,
New York, N. Y.

Dear Mr. Knap:

Application is hereby made for membership in the American Peat Society. Check in the sum of $5.00 for subscription to the Journal of the American Peat Society during the first year is inclosed. It is understood that the payment of this sum will admit me to the society and entitle me to all the privileges granted to members by the constitution. This action is prompted by my interest in the utilization of peat and the welfare of the society.

Yours very truly,

_____
(Signature)

_____
(Address)

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To Members of the American Peat Society:

The Executive Committee, to provide funds for the publication of the journal and to promote the wider use of peat, has determined to conduct a campaign for increased membership. The management of this campaign has been placed upon me. The duties of my gratuitious office as editor are already burdensome, but I am willing to undertake this task in furtherance of the society's welfare and of a cause in which I thoroughly believe. To fully inform the public of the commercial value of peat, to keep members posted on current scientific developments, and to convince the users of its merits are the objects sought to be accomplished, and the active co-operation of all members is solicited.

The Executive Committee, sitting as a committee on increased membership, has enlisted the entire membership to secure new members. The peat regions have been divided into 13 districts and a sub-chairman has been appointed for each district. Each sub-chairman is expected to communicate with every member in his district and tell him that he has been delegated to secure and submit through the sub-chairman one new application. The quota of each sub-chairman, exclusive of applications obtained by members in his district, is five. Failing to secure one new application, each member is expected to remit $5.00. Failing to secure his own quota, each sub-chairman is expected to remit $25.00. Officers and members of the Executive Committee are expected to obtain ten new members or present their checks for $50.00. A letter outlining the plan in detail will be mailed to each officer, member of the Executive Committee, and sub-chairman in a few days. All funds and applications should be sent to the secretary.

The campaign ends on February 28, 1922. A list of officers, members of the Executive Committee, district sub-chairman, and members will be published in the April edition of the journal. Opposite their names will be shown the quota of new memberships or alternative contributions allotted to each and the results that they have reported.

C. C. OSBON, Editor.

The publication of articles in this journal should not be considered an endorsement of them by the society or its officers. Manuscripts sent for consideration by the editor should be registered. Written discussions of papers are invited. Authors wishing reprints of articles are requested to correspond with the editor. Advertising rates will be furnished upon application to the secretary.

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Incorporated

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